METAL INDUSTRY

28 MARCH 1958

Copper Situation

THREE factors have played a part in reducing the current demand for copper and its alloys. First, its substitution, in times of scarcity, by other materials, secondly, the feeling by buyers that the price was too high or too uncertain and that the maintenance of stocks provided an undue risk in their business, and thirdly, the general recession in business activity. True it is that there are many uses for which there are no substitute materials for copper and its alloys, but it must be admitted that there is a wide range of uses where this does not apply. It must be remembered that in cases where other materials can be used as substitutes for copper and its alloys, price relationship plays the most important role.

That the question of substitution is a serious one can be gauged from figures released by the U.S. Government. An analysis of twenty-five industries which use, or have used, substantial amounts of both copper-base and aluminium-base mill products showed that in 1947 these industries accounted for 69 per cent of the total consumption of copper-base mill shapes and 38 per cent of the comparable total consumption of aluminium-base mill products. From 1947 to 1954 consumption of copper-base mill products by these twenty-five selected industries increased 1·6 per cent as compared with the aluminium consumption gain of 66·3 per cent. In other words, due to the uncertainties as to price and availability of copper and its alloys, the copper industry has remained static during the past few years while its competitors have been expanding their production and their sales. A similar trend is shown in the brass and bronze ingot trade. Thus in 1957 in the United States approximately 250,000 tons of brass and bronze ingots were shipped by the industry, a reduction of about 16 per cent from the year 1955. For the same periods the shipments of foundry products showed a reduction of only 9 per cent, indicating that manufacturers were reducing their stocks of ingot metal to keep their losses at a minimum.

There can be no doubt that the copper industry as a whole needs improved methods of marketing, increased sales promotion and basic research to meet the challenge presented by producers of other substitute materials. No industry can progress that does not keep itself in touch with changing times. Of course, the copper industry is not like a new industry in which continued spectacular growth can be expected every year. On the other hand, the newer metals can be expected to increase their consumption rapidly, but eventually their growth potential will level off in the same way as has occurred in the copper industry. Meanwhile all branches of the copper industry should continue to present to consumers the superiority of copper and its alloys for individual uses. In this respect the brass and bronze ingot industry is fortunate in that consumers cannot revert to other materials and obtain the required results. Nevertheless, it must continue to strive for better and better products to serve the new uses which are arising. For the copper industry in general, as the gap between the price of copper and those of its rivals narrows, the choice of the consumer will depend more on the intrinsic merits of the materials for the particular application than on their respective sale prices. It may be difficult to reacquire some of the users that have been lost, but they must be convinced that their place is with copper rather than with substitutes.

Out of the MELTING POT

Atmospheric Lubrication

WHETHER or not bearings can run without a lubricant, depends on whether the atmosphere in which they run can or cannot be described as a lubricant. This somewhat academic and belated conclusion can be drawn from some investigations recently carried out by Shell Development. Theoretically, a ball or roller bearing, in which the roller elements run on a race without slippage, i.e. with no sliding friction, should require no lubrication. Indeed, the viscosity of any lubricant introduced into the bearing should inevitably result in some drag. The absence of a lubricant would, it might be thought, also eliminate the complications that arise when the bearing has to operate at high temperatures at which conventional lubricants start to volatilize and decompose. In practice, ball and roller bearings are, of course, lubricated partly for the purpose of preventing dust, moisture, and other undesirable substances finding their way into the bearing. At high temperatures, unlubricated bearings were found to fail rapidly as a result of the formation of iron oxide and its highly abrasive action on the bearing. This is where a suitable atmosphere can prove useful by taking on the functions of a lubricant. Indeed, operation of a bearing at high temperature in a reducing atmosphere was found to be possible. Oxidation of the iron could be inhibited quite efficiently by providing a mixture of air and a vapour of a hydrocarbon. A variety of hydrocarbons were satisfactory for this purpose. So far as the inevitable sliding friction between the rolling element and the cage, and the resulting scuffing, are concerned, they could be prevented by the formation of a protective film during an initial running-in period at room temperature in the presence of a lubricant containing extreme pressure additives (sulphur, phosphorus or halogen compounds). Subsequent high temperature performance of the bearing in an atmosphere containing a hydrocarbon vapour is improved if the latter contains certain constituents capable of polymerizing to yield resins or gums, which then form additional protective films on the bearing surfaces. So far as the bearing materials are concerned, they should have a positive oxidation potential. In the case of bronze cages, for example, the reducing atmosphere removes the protective sulphur film, and cage wear due to scuffing sets in. Thus, if "air conditioning" is to replace lubrication by oil or grease, not only should the "conditioning" be well chosen, but the bearing materials should be such that they will "like" the conditions provided for them.

Same Principle

SOONER or later, ultrasonic welding was to have been expected to make its appearance, at least as a principle, in the adjoining field of powder metallurgy. All the conventional metal processing methods from casting (yes, casting), through rolling, extrusion, pressing, heat-treatment, etc., to surface finishing, somehow seem to find their way into the field of powder metallurgy. Incidentally, the official mention of the principle of ultrasonic welding in connection with metal powders dates back to June 26, 1953, and may thus antedate its first mention in connection with foils and other wrought metal products. In powder metallurgy, ultrasonic welding, during the cold pressing operation, is preceded by agitation by the ultrasonic vibrations of the particles of the metal powder in the die. This agitation produces a settling and consolidation of the powder into any corners, undercuts or crevices of the die cavity. Afterwards, as the pressure exerted on the powder by the plunger is maintained or increased, the ultrasonic energy, transmitted into the powder through the plunger, is dissipated in the powder as heat, which is generated at the points of contact between the inter-engaging particles. This dissipated energy causes sufficient local heating at those points to cause the particles to become bonded or welded to one another, possibly even by localized melting at the contacting areas. The resulting compact will, therefore, be an integrated body having a much higher strength as compared with a normally cold compacted body, and, therefore, capable of withstanding considerable handling without crumbling. Sounds as if ultrasonics might be just the job for strip rolling from metal powders.

Helpful Cold

LEADING refrigerator salesmen capable of selling their appliances to Eskimos, should find it increasingly easy to sell refrigeration to the metal-working industry. Indeed, it is probably not too far-fetched to conjecture that the increasing number of occasions on which freezing is nowadays to be encountered in metal-working operations is due to the success refrigerator salesmen have had in the homes of the engineers concerned with such operations, and the consequent conditioning of their minds to the acceptance of freezing as a simple, commonplace phenomenon. Two developments of recent date may be referred to as illustrating the range and variety of the applications that quick freezing is finding as an aid in process engineering. The first of these applications is to be found in the specialized field of production, by powder metallurgy, of components, such as turbine blades, with narrow internal passages or ducts, e.g. for cooling. The ducts are formed by cores of the required diameter and of a suitable material, which is either decomposed or volatilized during sintering, or which, for example, may be a suitable metal that will melt and infiltrate into the metal powder component during sintering. To locate the cores in the required relative positions, they are assembled in the required manner in a box, which is then filled with the metal powder. By introducing a liquid to fill the spaces between the particles of the powder and then freezing the liquid, it becomes possible to remove the powder and the cores from the box and to transfer the whole to a die without disturbing the positioning of the cores. The liquid is then allowed to melt, and the powder is compacted by pressing in a direction at right-angles to the direction of the cores. The resulting compact is then sintered. In the second application, freezing is arranged to perform a function akin to that of a machine tool component, namely, a clamping device. The work is positioned on the platen of the machine tool. The platen is then flooded with water, which is then frozen to grip the work tightly. By providing separate sources of cooled and heated fluids feeding a system of ducts in the platen, a complete clamp-unclamp cycle can be as short as 8 min. Ice clamping is being used to hold such delicate materials as honeycomb aircraft structures for milling, or such awkward materials as foamed rubber for concave disc cutting.

Skinner

Pressure Die-Casting Review

Control of Die-Casting Machines

IN the die-casting industry, attention has been directed for many years towards complete automatic control of the process. The advantages of a complete system of control are many, and although greater production might be one of the results it is not necessarily the most important or the most desirable outcome of a completely automatic system. Indeed, it would be generally conceded that the greatest single problem which would be solved if a successful automatic control system were introduced, is that of inconsistency of operation, due in part to the differences between one operator and another and also to operator fatigue. These factors, particularly in cold chamber machines, result in minute variations in the cycle which are sufficient to affect surface appearance and internal soundness.

Much progress has, indeed, been made, although an entirely automatic control has not yet been developed, except for the automatic machines producing very small parts at high speed, and existing controls are, for the most part, confined to the basic machine movements, such as die closure, injection time, die opening, and ejection. Attempts have also been made to incorporate automatic ladling systems on cold chamber machines, but so far their application has been relatively limited.

Electronic Controls

In the application of electronic controls and safety devices, many of the major manufacturers of die-casting machines have developed systems which reduce the task of the operator to the basic movements of die lubrication, push-button operation and casting removal, and this article gives an outline of some of these systems.

In general, the problem involved is to carry out a number of machine movements in a large number of sequences, and these sequences must be readily selectable in a simple manner. Certain basic safety interlocks have also to be provided. With the majority of die-casting machines, power is supplied by a built-in electric motor and hydraulic pump system.

The machine movements required on a normal die-casting machine are as follows:—

Prior to injection:—(1) Withdraw power-operated central ejectors (when used). (2) Insert one or more power-operated side cores. (3) Close die. (4) Inject metal.

After injection:—(5) Open die. (6) Withdraw side cores. (7) Eject casting. (8) Retract injection ram.

With the exception of (1) and (7) these movements may be required to be carried out in any order, and the die may be halted at any point along its stroke to insert or withdraw cores.

The power-operated ram which normally operates the ejectors may be required to operate central cores when necessary.

The foregoing applies to "cold chamber" operation. When operating machines under "hot chamber" conditions it is normally necessary to retract the injection ram after injection has taken place, and not at the end of the cycle as indicated by (8).

Peco Machines

Individual means adopted by different machine manufacturers to accomplish the required movements may vary. For instance, the system used by Peco (Projectile and Engineering Co. Ltd.) is as follows:—

All movements are carried out hydraulically and are selected electrically by means of solenoid operated valves. These valves are of three basic forms.

(1) Double solenoid un-biased valves, which select their associated rams in either direction when one or other of the solenoids is energized momentarily. The solenoids do not require to be energized continuously and the valves have no neutral position. They are normally used to control cores or ejectors, which are not required to take up a central position.

(2) Double solenoid spring-centred valves. These valves are also fitted with two solenoids, but are spring biased to a central position. A ram controlled by these valves will only move in either direction as long as one or other of the solenoids is energized. They are used for die control.

(3) Simple solenoid spring-return valves. These valves are hydraulically similar to type (1) but are spring biased to one end. The solenoid, when energized, overcomes the spring pressure and reverses the valve. They are used for injection control. Movements in a cycle may readily be arranged in any desired sequence provided they will accept identical instructions to proceed and will produce similar signals on completion of those instructions.

Power is supplied to the control circuit via two lines.

The casting cycle is started by depressing a push button. This operates a series of contacts and switches, which energize the valve solenoid, causing the power-operated ejectors to retract. After completion of this movement the current to this solenoid is interrupted and flows back to a second solenoid to insert a power-operated side core. As this movement is completed, the current flows to energize a further solenoid, which starts the die closing movement.

It will be remembered that, since the die may be required to halt at some position between fully open and fully closed, the die control valve is spring-centred. To obtain positive locking during injection it is, therefore, necessary to maintain the die-closing solenoid energized.

When the die has fully closed, the "die locked" indicator lamp will be illuminated and current becomes available at the "firing" footswitch. A master interlock switch is operated at the same time as the die is locked, ensuring that injection cannot take place until the die is locked.

All movements have now been completed on the closing half cycle and the machine is ready to inject when the "firing" footswitch is closed.

Metal is now poured into the injection cylinders, the foot switch is closed, and current flows. The injection solenoid valve is energized to inject and the timer begins to run. A relay is, at the same time, released to prepare the circuit for the return half cycle after injection. The timer determines the duration of injection. When it times out, the energization of a relay commences the return or reverse half cycle of operations, which begins with the de-energizing of the die-closing solenoid. The die-opening solenoid will then be energized and the die will open. When the die reaches the fully open position, the circuit resets to its original rest position. Finally, the injection ram will retract, thus completing the cycle of operations.

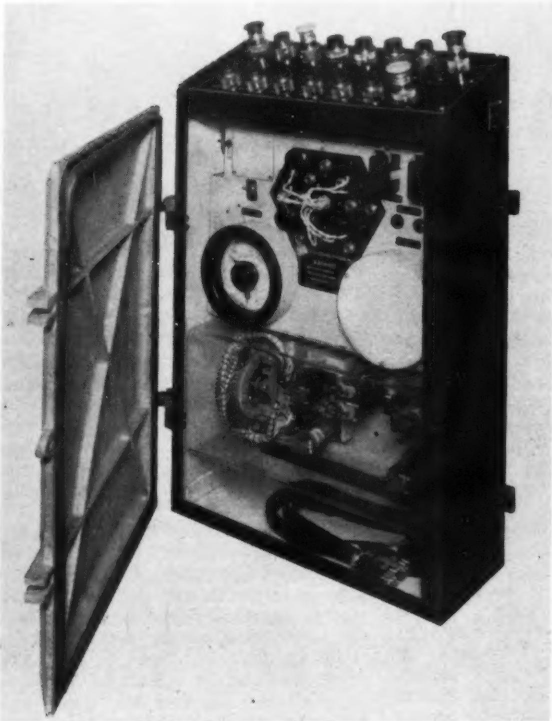
Of necessity, the above description is over-simplified. In practice, ten jack sockets are fitted to cater for the following facilities:—

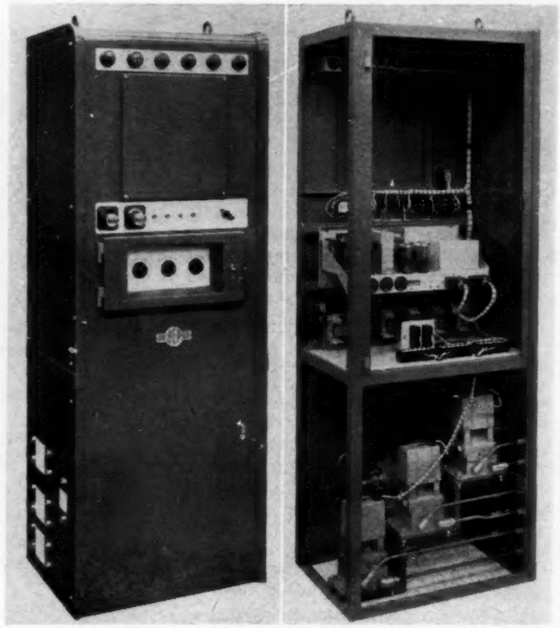
(a) Power-operated ejectors (which may also be used for central core pulling).

(b) Two independent power-operated side core facilities.

(c) Die movement with halt facility.

The following points also require consideration. Irrespective of all other considerations, the push button must be depressed during the complete die closing stroke. In practice, when a safety guard is not provided, a second button is included in the circuit and is sited on the machine in such manner that the operator has to use both hands simultaneously to close the die. This





Left: Fig. 1—The control cabinet used with the Peco die-caster, showing the door open

Above: Fig. 2—Two views of the control unit for the Schultz die-casting machines. The front of the cabinet is shown on the left, and the interior on the right

keeps both hands occupied and, therefore, clear of the die space during the critical closing period. When a guard is fitted, the second button may be omitted altogether.

No indication has been given of the method of obtaining die halt. In practice, both the die-closing and die-opening movements are split into two separate stages. Taking the die-closing movement, during the first stage the die is closed to some adjustable half-way position. During the second stage, the closing movement is completed. The two stages are connected to separate plugs.

When interrupted operation is required, both plugs are inserted into adjacent jacks; the movement is then carried through without pause.

When it is required to carry out some other operation with the dies in a mid position, the die plugs are spaced out and the plug of the desired movement is inserted in the jack between them. It may be necessary, for a variety of reasons, for the operator to halt the progress of a closing half-cycle and to return the machine to the rest condition. An "emergency" button is fitted to enable this to be done in a simple and reliable manner. At any time up to the point where actual injection takes place, by operating the emergency button the operator may halt the progress of the closing half cycle and undo all operations already completed without causing any damage to the machine or die.

The foregoing description relates to the "cold chamber" method of operation, when the injection ram is retracted at the end of the cycle. A simple alteration to the circuit enables the machines to be operated under "hot chamber" conditions, where the injection ram is retracted after an adjustable "cure" period and before the die is unlocked.

By means of a rotary switch, a number of "setting" buttons may be brought into operation. These buttons enable all operations to be carried out individually with only a minimum of safety interlocks in operation. It will be appreciated that, under these conditions, responsibility for correct sequence is entirely in the hands of the setter. For this reason the rotary switch is normally locked in the "auto" position, when only the "cycle start," "die close" and "emergency" buttons are effective.

It occasionally happens that a power-operated ejector or core sticks; "joggle" buttons are, therefore, provided. By means of these buttons the offending motion may be freed without having recourse to the "setting" buttons.

The control cabinet used on Peco die-casting machines is shown in Fig. 1.

Schultz Die-Casting Machines

The Schultz electronic cycle controller, although similar in essentials, has a number of different features from the system just described. This control unit was designed originally by the Schultz Die-Casting Company, of Toledo, Ohio, U.S.A., and is now manufactured, like the Schultz die-casting machine, under licence in Britain by Vincent Engineering Co. Ltd., of Glasgow.

The basic machine operation is simple—a valve in the hydraulic circuit to control die closing and opening, and another in the air line to control injection. This allows fast operating rates, but it was found under manual operation that the maintenance of a properly-timed operating cycle depended entirely on the operator's skill, and a change of operator could result in a difference in the quality, as well as the quantity, of die castings produced.

With the control cabinet a typical sequence is as follows:—

On pressing the "start" button a solenoid is energized which admits air to the die closure mechanism (an air cylinder operating a four-way hydraulic valve) and to the associated Robotair safety device.

The safety bar is withdrawn, the die closes at a predetermined speed, and the conclusion of the closure stroke actuates a limit switch. This brings into operation a 0·75 sec. delay timer which, after the expiry of the 0·75 sec., energizes the "slow injection" valve and thus starts the plunger on the injection stroke.

The slow phase of the injection stroke can be preset (in units of 0·1 sec.) to last any period between 0 and 2 sec. After the expiry of this period a check valve, which has been bled to give slow injection, is opened fully.

Simultaneously, the "full pressure" timer is energized and the full line pressure is applied to the plunger for

a further period, which can be varied between 0 and 10 sec.

When this time has elapsed, the plunger is retracted and, at the same time, a further timer is energized. This, controlling the casting period, has a range between 0 and 20 sec. After this time has elapsed, the air supply to the die closure valve is exhausted to atmosphere.

The main hydraulic valve then opens and the moving platen retracts. At the completion of the die operation a "die open" limit switch is actuated, which resets all the timers and leaves the control system in a state of readiness for the next machine cycle. The machine remains in the open position until the start button is again pressed.

Provision is made in the cycle for a stop button, which halts the sequence at any point (the dies always returning to the full open position), and for a "core-pulling" button which, when in use, stops the cycle at the end of the chilling period, thus prolonging the closure time as long as the operator requires. Different coloured warning lights show which phase of the cycle is in operation.

For setting, testing, etc., the control has manual switches which allow closure and opening to be carried out independently.

Provision is also made in the cabinet for a pyrometer control, which can be mounted in the upper part of the cabinet. With pyrometric control, fluctuations in metal temperature result in resetting of the valve in the gas or oil line. Although the latter have been the normal heating media for the Schultz machine, Birlec-Tama low-frequency induction furnaces have been used recently with considerable success, resulting in increased purity of alloy and enabling a metal temperature of $\pm 5°C$.

The following safety features are incorporated. The metal injection or plunger operating valve has an interlocking feature so that it is impossible to operate this valve unless the die is completely locked, and the die cannot be opened until the pressure has again been removed from the metal plunger.

A safety arm, operated by an air cylinder, engages under the rear toggle link, preventing the platens being opened when the injection sequence is in progress.

A cam device (Robotair) on the crank introduces a mechanical safety lock on the moving platen by causing a bar to drop across the upper tie bars when the platen is in the open position. This bar is automatically withdrawn before the platen moves forward. By this safety feature the risk is eliminated of the machine closing accidentally.

The advantages claimed for this system are:—After each new job has been on trial to find out the ideal time factors in the operational cycle, these conditions can be made permanent by setting them on the dials in the cabinet. There is a control window housing the dials, and this can be locked after setting. All the sequences in the operating cycle will thus be strictly controlled throughout the shift.

The equipment is not complicated and, because the electronic unit is not an integral, built-in part of the machine, it does not present insurmountable difficulty in the event of servicing being required. The cabinet can be by-passed by means of cocks in the air lines to allow manual operation to be carried out by pilot air valve control. With the pilot valve controlling metal injection, two-stage injection can be obtained.

The Schultz electronic cycle control unit, manufactured for Vincent Engineering Co. Ltd. by Lancashire Dynamo Electronic Products Limited, is shown in Fig. 2.

Lester Die-Casting Machines

In the range of Lester die-casting machines, built by Dowding and Doll Limited, the smaller machines include a safety circuit which prevents the injection taking place until the dies are locked and the foot switch is depressed. The operating sequence is automatically controlled by electric timers. This machine does not include core pulling attachments.

The larger models of Lester machines have more comprehensive automatic mechanisms, and the complete sequence of the machine, including ejector, core pulls, plunger, etc., is completely interlocked so that failure at any one stage will prevent the next operation taking place. Once the operator has closed the die and poured the metal (in cold chamber machines), the machine becomes fully automatic and is controlled by a time cycle. Once the machine has been set to a given time cycle, the control panel can be locked to prevent any interference by the operator.

In these machines electronic circuits constitute what might be termed the "nerves" of the machine, and the hydraulic equipment the "muscles." The following outline of the operation of the cold chamber HHP-1-CC machine indicates the chief features of the Lester system. With electric power running to the motor starter, pressing the start button on the control panel box will start the motor turning. The motor turns the pump, which sucks oil

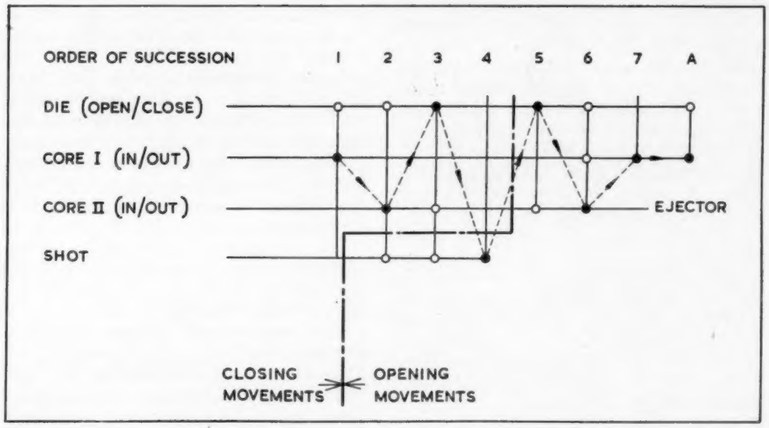
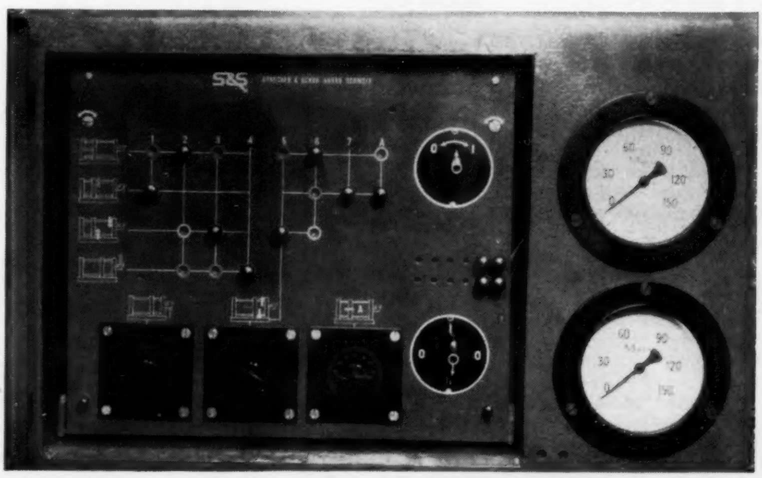


Fig. 3—Diagrammatic arrangement of the Buhler co-ordinator selector

Fig. 4—The co-ordinator selector built into the control box



from the machine base and exhausts it from the pump outlets into the pipe circuit to an operating valve which controls the opening and closing of the locking cylinder. This valve is controlled by the operator in closing the die. For open die, the electrical timer, through solenoid action, operates this valve. The valve is open from its pressure port to the rod end of the link cylinder. With the machine idling, the die is open and the links are all the way home in the "return" or open position. Therefore, the oil is locked against a dead end.

The oil also flows through a check valve to and through a 2 in. globe valve to a four-way valve, which controls the forward and back movement of the aluminium shot plunger. This valve is open from its pressure port to the rod end of the plunger cylinder. With the machine idling, the shot plunger is all the way home in the "return" position. Again, the oil is locked against a dead end.

A pressure pilot line is used to operate valves which shift the spool of the four-way valve. At the ends of each of these lines, then, the oil runs into a dead end and the pressure in the oil line rises as the combination pump continues to turn.

With the main motor running, supplying oil at the necessary pressures, the sequences are as follow. The main switch is closed and current is fed to an auto ejector switch. A handle on the front of the machine must be pulled to operate the ejector box and close the die, thus energizing the ejector return. Oil flows to the rod end of the ejector cylinder, and the ejector withdraws into the movable die plate. Next, through a series of switches, the core return is energized and the core is set on the movable half of the die. When the cores are fully home, the die close is energized and the dies begin to close.

When the die is fully closed, the cover core return is energized and the cover core is set in the stationary die half. The operator, having loaded the metal cylinder with metal, depresses the foot switch and timer 1 measures its time period. On completion of this period, a number of electronic sequences takes place, the shot plunger is energized and timer 2 measures its time period. The shot plunger then moves forward and oil, boosted by discharge from accumulator, is discharged to the shot cylinder head end, giving greater shot speed and a final high pressure (up to 2,000 lb/in^2) squeeze.

Further electronic sequences control the cooling period and prepare for the withdrawal of the core slides and ejector plate operation. The cover core is next pulled, and then the die is opened. Finally, the cores in the movable half of the die are pulled and the ejector moves forward to eject, thus completing the machine cycle. Both shot and plunger speeds are fully adjustable, and all motion on the machine may be manually controlled for setting purposes.

Buhler Pressure Die-Caster

The Buhler pressure die-casting machine has automatic interlocked cycle control, which enables the caster to predetermine the order of succession of operating movements, so that they will take place according to a certain selected programme in the required sequence.

All Buhler machines can be operated either by manual control or automatic cycle control, the change-over from manual to automatic being obtained by simply switching a hand-switch. By working the machine with manual control, all operating movements are obtained by individual hand-switches for the various movements, with little or no interlocking safety device. Manual control, generally speaking, is used only for setting up of dies or testing of new dies. For normal production runs, control is automatic.

In the following example, with a die having two independent core pull groups and hydraulic ejector, non-automatic control, ten manual operating movements would be necessary on a cold chamber machine.

Locking movement:—(1) Core pull group 1—"in." (2) Core pull group 2—"in." (3) Die close. Opening movement:—(4) Injection (plunger forward). (5) Die open. (6) Core pull group 2—"out." (7) Core pull group 1—"out." (8) Plunger return. (9) Ejection. (10) Ejector return.

Employing a similar sequence, but working with automatic control, the number of switching operations of the die-caster is reduced to two.

(1) Closing of die by simultaneously pressing two push buttons "start" (two for safety). (2) Releasing of shot (injection), die opening after a preset time lapse (electric timer), reckoned from start of injection impulse, which is given by means of a foot pedal immediately after pouring of molten metal into the filling sleeve.

With hot chamber machines, only one impulse is necessary to start and complete the entire cycle (die close, shot, die open), as the metal feed is automatic.

By means of limit switches, each subsequent movement now takes place automatically in order of succession of predetermined sequence. Between movement No. 4 (shot) and movement No. 5 (die open)—solidification period of casting. Between movement No. 4 (shot) and movement No. 8 (plunger return) — time for lubricating the plunger on cold chamber machines when in forward position. Between movement No. 9 (ejection) and movement No. 10 (ejector back)—time for removing the casting and lubricating ejector pins.

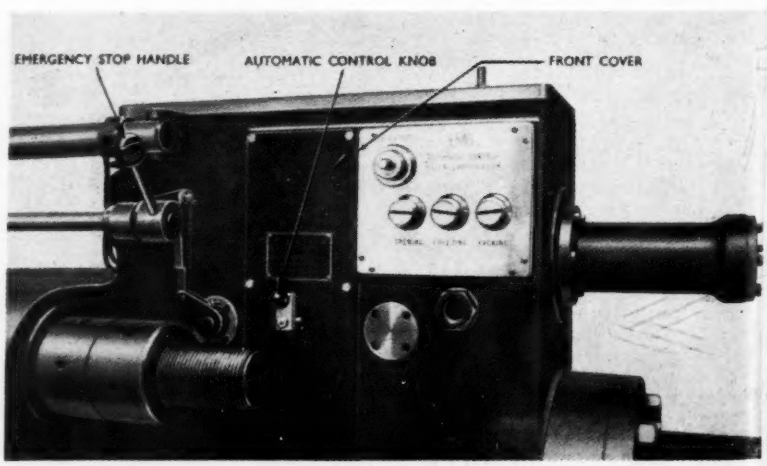
These intervals (time lags) can be adjusted to the desired time to suit the particular production by means of electronic timers, and the movements following the intervals take place automatically after the preset time has elapsed. Upon completion of movement (10) of the example, the machine stops and is ready to start a new cycle.

The hydraulic cores can be interconnected with the opening and closing cycle wherever required. A "co-ordinator selector" enables automatic cycling of all movement sequences generally occurring in practical pressure die-casting production. The cycle programme includes die open and close, injection, ejection and, depending on the type of machine, two or three core pull groups.

The co-ordinator selector is a special plug switchboard built into the control box, as shown in Figs. 3 and 4.

On this switchboard, depending on the particular programme, the various movements can be selected to the proper sequence by plugging in accordingly. In Fig. 3, the marked circles

Fig. 5—The arrangement of the controls for automatic operation of the E.M.B. die-casting machine



show the position of the plugs when working with the above-mentioned programme of ten movements.

This sequence selector can be incorporated in the same form on horizontal and vertical cold chamber machines, as well as on hot chamber machines. Cores which are drawn by means of angled pins are not, of course, included in automatic cycle programmes as they are drawn mechanically with opening of die.

E.M.B. Air Operation

So far, the automatic controls that have been discussed have been incorporated into machines operated hydraulically. At least one manufacturer, however, uses compressed air as the operating medium. In these machines, manufactured by the E.M.B. Company Ltd., West Bromwich, the automatic operation of the machine is controlled by an air motor built into the locking head. Power is derived from a double-acting air cylinder which rotates, by means of a rack, the pinion on the main camshaft of the machine. In the one direction, the speed of rotation through different parts of the stroke, is controlled by three valves in an oil-controlled timing unit, regulating the flow of oil from one side of a piston to the other. In the other direction, the oil is allowed to pass through the piston by means of a non-return valve.

The three valves control the sequence while the operating handle is moving from the injection to the die opening position. To operate the machine automatically, the air motor is connected to the main camshaft by a sliding key inside the shaft, moved by the automatic control knob (Fig. 5).

The fourth valve controlling the length of ejection is operated by a stop rod from the platen. A cam, fitted on this stop rod, rotates the valve at the end of the platen stroke, and opens the oil cylinder (on the automatic control) to the reservoir, thus giving a quick movement to the platen. By slackening off the hexagon and rotating the dial, the relation between the valve and the cam is adjusted to give different lengths of quick stroke.

This stop rod operates another pilot valve at the end of the stroke, which is brought into operation when the full automatic knob is pulled out. This valve operates the automatic handle by means of a small air cylinder.

The guard is operated by means of an air cylinder, with air on one side of the piston and oil on the other. When the guard is opening, the air pushes the oil into a small reservoir on the back of the machine. To close the guard, air is admitted to the surface of the oil in the reservoir.

The oil valves in the main locking head are controlled by levers from the oil cam shaft. The pivot pins of these levers are eccentric. When the emergency lever is operated, these eccentric pins rotate and both oil valves close, arresting the movement of the platen.

Three forms of the E.M.B. machine are manufactured:—

The hand-operated machine enables very delicate control of the platen to be obtained, with platen stops to accommodate inserts over any part of the stroke.

The single cycle automatic machine provides an automatic cycle, in addition to hand operation (the stops are omitted).

The fully automatic machine for hot chamber working closes under light pressure and, if the die faces are clear, applies the lock and injects the metal. If a casting should be trapped or there is excess flash, the machine stops without damaging the die. The flow of cooling water for the die is automatically controlled. All these forms can be supplied as cold chamber machines, or as hot chamber machines heated by coal gas, bottled gas, or oil.

Correspondence

Correspondence is invited on any subject considered to be of interest to the non-ferrous metal industry. The Editor accepts no responsibility either for statements made or opinions expressed by correspondents in these columns

The Presentation of Metallurgical Information

To the Editor of Metal Industry

SIR,—The letter from Mr. I. W. C. Cosens of Sheffield, published in your issue of 14 March, is curiously inconsistent. He starts by disagreeing with the matter of Dr. Jenkin's admirable article, alleging that many people *do* say "tin, copper-and-nickel," when what they mean is "tin, copper, and nickel," and he adduces this unfortunate abuse of spoken English as an argument in favour of its being similarly abused when written.

To confuse matters, however, he then goes on to say that "no amount of juggling with the accepted rules of punctuation can mitigate such evils," referring to some of the other examples of obscure writing quoted by Dr. Jenkin. As Dr. Jenkin's point in the former matter was that strict attention to correct punctuation was one of the first essentials for clarity, this part of Mr. Cosens' letter is inexplicable, except on the premise that he supposes Dr. Jenkin's punctuation to have been unorthodox. If this is what Mr. Cosens thinks, I would refer him to Fowler, "Modern English Usage," 1950 edition, p. 22, AND 2, and to Collins, "Authors' and Printers' Dictionary," 1956 edition, p. 14, "and" or ",and", where he will find the normal and correct usage in this matter clearly laid out. The importance of complete orthodoxy in the punctuation of such enumerations cannot be too greatly emphasized, since it is one of the most fruitful causes of confusion.

I wholly agree with Mr. Cosen's last paragraph, which, however, again appears to be at variance with the previous one. A serious study of the rules of good, clear English would certainly lead to the more accurate transmission of information, whether the writers are metallurgists, scientists or technologists, or any other type of writer setting out to convey information.

Yours, etc.,

J. F. P. H. Greene.

5 Elm Bank Gardens,
Barnes,
S.W.13.

Obituary

Mr. W. van Ments

WE regret to record the death of Mr. Wolf van Ments, at the age of 68. He had been a noted figure in the metal industry in the Midlands for over 40 years, and was made a director of B. J. Perry and Company Ltd. in 1931. He had been a member of the Birmingham Metal Exchange since 1920.

Mr. Maurice Slater

ALSO connected with the metals industry for many years was Mr. Maurice Slater, whose death occurred recently at the age of 84. Mr. Slater was with John Harper and Company, of Willenhall, for many years, and was managing director of that company when he retired in 1935. He had also been chairman of C. and L. Hill Ltd.

Mr. Joseph Smith

IT is also with regret that we report the death, at the age of 62, of Mr. Joseph Smith, who, for the past three years, had been deputy chairman of Edwin Danks and Company (Oldbury) Ltd., a firm which he had joined as an apprentice in 1909. After the first world war he spent a year as deputy assistant to the chief engineer at the I.C.I. Kynoch Works before rejoining his old company.

Research Progress

Cumulative Fatigue Damage

BY RECORDER

IN the laboratory, fatigue tests are usually carried out in such a way that the specimens are subjected to a cyclic stress variation between two fixed values. One of these stress levels may be zero, both may be "positive" or of the same sort, e.g. tensile, or one may be tensile and the other compressive. In practice, however, the stress fluctuations that occur are likely to be irregular, and will seldom show the uniformity of repetition that characterizes most experimental cycles. Among the variables that will determine the life of a structure then, are the levels of stress attained, the number of times each stress is reached, the duration of each loading, and the rapidity of change from one stress to the next. An infinite variety of conditions is thus possible, and some way of synthesizing their effects must be found to enable predictions of structure lives to be made from the results of relatively simple experiments. The concept of cumulative fatigue damage gives the most promising approach to this problem.

Taking the case of fatigue in bending, it is clear that if a specimen is subjected to n_σ cycles of an alternating stress $\pm\sigma$ at which failure would occur after N_σ cycles, the material is damaged to such an extent that a further $N_\sigma - n_\sigma$ cycles would cause failure. It has been suggested that if a variety of cyclic stresses is involved, failure will occur when $\sum \frac{n_\sigma}{N_\sigma} = 1$ and to a certain extent this hypothesis has been found to give moderate agreement with experimental evidence. The discrepancies which exist, however, have required a re-examination of the dependence of the amount of damage incurred by a specimen on the number of stress cycles and the stress level. Such work has been carried out at Nottingham University by B. K. Foster.[1]

Damage Fronts

The basis of Foster's research lies in the fact that in bending fatigue, damage by cyclic stressing is confined to the surface layers of the specimen, the depth of the damaged skin depending on the number of cycles and the imposed stress. It is possible to assess the amount of metal so damaged by a technique developed as a result of observations by N. Thompson.[2] He found that if a fatigue test was interrupted prior to failure and the outer layers of the specimen were then removed by electrolytic polishing, he was able to obtain a new, somewhat smaller specimen, which behaved in subsequent fatigue tests as though it had not previously been stressed. Foster has shown that the effect can also be obtained by mechanical rather than electrolytic polishing, but he also found that if an insufficient depth of metal was removed, the polishing operation had no effect on the total fatigue life of the specimen. He suggests, therefore, that a damage front exists which can be eliminated by sufficiently deep or sufficiently repeated polishing so that the effects of previous stressing are completely removed. If the front is not removed by the polishing, however, further stressing will allow it to proceed "towards the centre of the specimen unaware of the repeated polishings of the optimistic experimentalist." The position of the damage front can thus be determined by studying the effects of varying the depth or frequency of polishing on the subsequent fatigue life of the specimen.

With this object, Foster carried out a series of experiments using mild steel specimens. The surface layers were removed at various stages of the fatigue test by polishing with emery paper, the depth removed and the frequency of polishing being controlled. These operations were continued either until the specimen broke or until the life exceeded twice that expected from the normal fatigue curve. In the latter event, the test was continued without further polishing, and if failure then occurred at a total life of approximately three times the expected normal value it was concluded that the polishing had removed all damaged material. In all cases, the load was reduced after polishing to maintain constant maximum stress. In subsidiary experiments it was shown that the effects observed were not influenced by the need to stop the tests for polishing.

In a typical set of experiments, specimens were run at ± 21 tons/in^2 and the removal of 0·0005 in. from the surface was performed every 2×10^5 cycles. No increase in fatigue life was obtained and a similar result was given when the polishing was done every $1{\cdot}5 \times 10^5$ cycles. When the frequency of polishing was increased still more, to every 10^5 cycles, however, double the normal life was obtained without failure, and a further "life" was run without polishing before the specimen broke. For this stress level, then, the damaged front progressed 0·0005 in. or less in 1—$1{\cdot}5 \times 10^5$ cycles. By means of a number of tests of this kind, it was possible to construct a curve showing the position of the damage front below the surface of the specimen after various numbers of cycles, and similar curves for various stress levels were, in fact, obtained.

These results were plotted using log-log scales, and it was found that the damage front depth:number of cycles points then gave a reasonably good straight line. It was also observed that if the length of the fatigue crack in a specimen broken normally was assumed to be the same as the depth of the damage front, another point on the front depth : cycles curve was obtained which also lay on this straight line. Although this result is in itself consistent, it implies that at failure the damage front lies at a depth exceeding the radius of the specimen which, for symmetrical bending tests, seems to be a feature requiring some explanation.

Predicting Fatigue Behaviour

The family of damage front curves at different stress levels resulting from the above experiments was next used by Foster to predict the fatigue behaviour of the material when the stress level was changed during the test. If, for instance, a specimen is stressed at a given level for a known number of cycles, the position of the damage front can be read off from the curves. If the stress level is then changed, the condition of the specimen corresponds to a position on the damage front curve of the new stress level so that the progress of fatigue at the latter stress can be followed on this new damage front curve. Tests of this nature, using different values of n_σ, were done and the predicted lives compared with the actual results, and also with the lives predicted from the rule that $\sum \frac{n_\sigma}{N_\sigma} = 1$ at failure. It was found that the lives obtained from the damage front curves more nearly agreed with the experimental values than those predicted from the formula:

$$\sum \frac{n_\sigma}{N_\sigma} = 1$$

As Foster points out, his work was confined to tests in which the stress system was symmetrical and relatively simple, and does not cover the question of the nature of fatigue damage. It may, however, lead to methods of predicting the effects of complicated cyclic loadings which will be more reliable and accurate than those now available.

References

1 B. K. Foster; *Aircraft Engineering*, 1957, **29** (341), 211.

2 N. Thompson; *Nature*, 1955, **175**, 980.

PROGRESS IN HEATING FOR METAL MELTING AND THERMAL TREATMENT

Fuel Efficiency

(Continued from METAL INDUSTRY, *21 March, 1958)*

FURTHER extracts are published here from the recent informal discussion organized by the Institute of Metals on the subject "Fuel Efficiency in the Melting and Thermal Treatment of Metals."

DISCUSSION

A. E. Mordin (Combustion Equipment Ltd.):

Could some information be given on automatic control of furnaces fired by oil or gas, especially on the relative merits of on/off control, high/low control, and modulating control, what instruments are available, particularly for modulating control, and what are the costs involved?

A. Higgs (West Midlands Gas Board):

Much depends on the process which is in question. The ceramic industry, for instance, on their batch-type kilns, where they are progressing a load up to a given firing temperature, invariably go in for modulating control, because on/off control tends to give them fluted ware, a sudden burst of heat, and then a pause. In the ordinary types of billet heating furnaces and metal melting furnaces and the like, high/low control has been found satisfactory. Personally, high/low control seems preferable to on/off on any furnace application. There may not, indeed, be any substantial saving, by fitting fully modulated control on the average type of heat-treatment furnace; but any specific type of furnace is a case for individual consideration.

A. E. Mordin: Die-casting was particularly in mind.

A. Higgs: We have some very large gas-fired installations for die-casting, and on all those installations there is high/low control. I do not think that we have ever explored the merits of fitting modulating control on that type of furnace.

P. F. Newman (Petrofina (Great Britain) Ltd.):

For the automatic control of aluminium melting processes, what are the couples sheathed in? Is any trouble experienced with the couples? If a metal sheath is used, care must be taken regarding metal contamination of the special type alloys. On the other hand, if sillimanite sheaths or some other form of refractory sheath is used, it is continually being broken by ham-fisted die-casters.

A. E. Mordin: There is a firm in Birmingham that uses a stainless steel sheath in die-casting furnaces, 27 per cent chrome. They say that these last six months, but they take them out every week, paint them with something, and put them back again. Another firm is experimenting to try to find the right type of sheath. Meehanite sheaths do not last very long, according to reports from works engineers, and the mullite sheath which has been offered for this job is easily broken and not very satisfactory.

D. W. Brown (Morgan Crucible Co. Ltd.):

There is no perfect sheath for this job at the moment. All metals seem to dissolve in molten aluminium if they are clean and properly in contact with the aluminium. In my experience, any nickel-chrome alloy is no better than the ordinary meehanite or cast iron. Any metal tubes depend entirely on the refractory coating, which must be applied at regular intervals. So long as that refractory coating remains intact the tube gives a good performance; but if the coating breaks down, through attack by fluxes or damage by the operator with a ladle, or for any other reason, the tube is attacked at that point and gives a bad life; it suffers from pitting corrosion, which can go rapidly through a tube once alloying has occurred at one place. If a metal tube is used, it must be taken out at regular intervals and given a refractory wash.

Tubes of fused alumina, mullite, and so on, will not stand the thermal shock of being immersed in an aluminium bath without careful pre-heating. If made thin, they will stand the thermal shock if pre-heated a little, but they are easily broken by the operator with a ladle. If made thick, they are reasonably robust, but have to be pre-heated almost to the temperature of the molten aluminium before they are immersed.

Silicon carbide tubes have a number of advantages; they are strong, they have good thermal conductivity, and they will stand a fair amount of thermal shock. Here again, however, the trouble is that if the tube is made $\frac{3}{4}$ in. or $\frac{1}{2}$ in. thick to give strength it is rather slow in response to temperature changes, and at the same time it needs very careful pre-heating.

There is on the market a composite tube which is an attempt to get the best of both worlds. It is a thin mullite tube, closed at the end and sealed into an open-ended silicon carbide tube extending almost to the bottom of it. This is an attempt to get the strength of the silicon carbide and, at the same time, a quick temperature response from the use of a thin closed-end tube inside; but these composite tubes are not perfect and can be broken by the ladle if hit hard enough. They also require some pre-heating, but pre-heating to about 200°C. is enough, and they have not to be elaborately and carefully pre-heated.

Many trials of these tubes have been made, and these trials can be divided easily into two groups. One user finds that the tubes last three or four months, while another says that they always break at once and are useless. It depends on the care used by the furnace operator in getting them into the melt. The two important items are pre-heating and the avoidance of mechanical damage.

Regarding automatic thermal control on aluminium die-casting furnaces, again, a great deal depends on the job. Whether modulating control, or on/off control, or high/low control is used depends on whether the furnace is used mainly for maintaining—i.e. holding temperature—or mainly for melting, or is switched from one to the other. It also depends on the heat input of the burner compared with the heat required for holding. If the furnace is used mainly for holding temperature a small burner can be used, a burner which, when full on, supplies little more than enough heat to hold the temperature at the right degree. It can then be run with on/off control. If, on the other hand, the furnace is intended for melting as well, and has a larger burner, on/off control results in poor accuracy of control. When the burner is turned off, the furnace refractories have reached a temperature of, perhaps, 1,400°C., compared with a metal temperature of, say, 720°C., so that although the burner is turned off the metal temperature goes on rising, and it can rise 50°C., or even as much as 100°C. in extreme cases. With a furnace of that kind, used for melting and having a large burner, and capable of a high heat input, on/off control is unsatisfactory, and high/low control is much better.

Modulating control tends to be expensive to install. The ordinary die-casting furnace is, after all, a cheap furnace, and a die-casting foundry may have 20 such furnaces. If the control gear costs three times as much as the furnace there is an understandable reluctance to put it in.

With electrically-heated furnaces, on/off control is quite easy, and modulating control or high/low control is usually inconvenient. The resistance-heated furnace is usually intended primarily as a holding furnace, and has a low heat capacity in the refractories, so that accurate control can be obtained with a simple on/off controller.

Mr. Williams (Stein and Atkinson Ltd.):

With regard to concentrated combustion, the use of concentrated combustion does not always lead to fuel efficiency, but it does lead, as a rule, to production efficiency.

Surprisingly, no reference has been made, particularly in connection with the treatment of aluminium, to the use of convection. It is necessary to treat the subject boldly, putting the heat in by gales of air or wind and not just by gentle breezes. Another subject not touched on is the use of radiant tubes, in which either gas or oil, usually a lighter oil, is burnt, and which, added to the benefits of convection heating both around the tubes and around the charge, give what is virtually equivalent to electric resistance heating. There seems a very big future for the really high convection job, whether electric or gas-fired tubes. Usually it is possible to use radiant tubes only where it is not desired that the products of combustion come in contact with the metal. They allow the use of a carefully-controlled atmosphere to preserve surface temperature.

A. Paterson (Shell-Mex and B.P. Ltd.):

There is a gasifier on the market which was developed in France, the O.C.C.R. gasifier. There are a few installations in this country, mainly for soaking pits and billet reheating furnaces. The advantage of a gasifier is that one tends to get a gaseous mixture wherein one can control the combustion conditions. It is possible with this particular gasifier to get below a stoichiometric mixture so far as the reducing atmosphere is concerned. It does not detract unduly from the emissivity of the flame, and it is possible to

control the flame better than with the conventional burner. It has been claimed that there is a tendency to inhibit sulphur deposition. This has not been proved, but there seems to be a tendency in that direction. There are about 200 installations on the Continent where these gasifiers are used on malleableizing furnaces, aluminium melting, gas retorts, and generally in the metal industry. In this country they have not been used, so far as is known, in the non-ferrous industry, but they have been used for billet heating and soaking pits.

J. C. Harris (Birlec Ltd.):

Regarding forced convection, in low temperature heat-treatment the heat transfer by radiation, as is well known, is extremely poor, being dependent on the fourth power difference. It is, therefore, necessary to use convection heating, and the heat transfer by convection is proportional to the velocity of the gases being circulated. From the point of view of fuel efficiency, that has introduced some difficulties for furnace designers because, when dealing with velocities of up to about 70 ft/sec., quite a big pressure differential occurs in the furnace on the suction side from the pressure side of the fan, and this is very directly affecting the losses due to the furnace walls, so that it is not practicable to think in terms of direct conduction losses, because there is some convection loss through the walls. The pressure causes the gases to percolate through the walls and transfer heat to the casing by carrying the heat through the wall, and not just conducting it through.

To meet this, attempts must be made to prevent the transfer of heat through the wall itself. The normal wall of a radiation furnace probaby consists of a firebrick lining backed up by some insulation. In the interests of fuel economy and efficiency, recently the refractory wall has been displaced by the insulating refractory wall. It is the porosity of this insulating refractory wall which accounts for the difference in the heat losses between the old, conventional type of furnace and the new type. With the refractory wall for the radiation furnace there is practically no temperature drop through the refractory, and there is a temperature drop through the insulation. With the insulating refractory wall there is a temperature drop through the insulating refractory, and then there is a drop through the insulation.

A casing temperature may be about 70°C., but as soon as forced convection is introduced losses occur through the wall. There may be temperatures as high as 200°C., giving tremendous losses. This necessitates avoiding the percolation of the high velocity gases through the walls. This can be done by reverting to the refractory lining, which is impervious to these gases, or by inserting some impervious material such as asbestos or sodium silicate, or it can be done by doing away with this lining altogether and having a metal lining. A metal lining introduces a number of very severe difficulties in the form of expansion and contraction considerations, and another big difficulty with the metal lining is that it has to be supported from the casing at very frequent points, and these themselves introduce a further conduction loss to the casing. The introduction of forced convection, therefore, has involved the furnace designer in quite a number of problems with regard to efficiency and minimizing wall losses.

The question of proportional control has been raised. There is one instance in which it is extremely advantageous, and that is on a continuous furnace, for instance, in the non-ferrous industry for annealing brass tubes, with a direct gas-fired furnace maintaining a protective atmosphere in the furnace from the products of combustion. With high/low control there will be a fluctuating supply of gas to the chamber, which may or may not be, and in most cases is not, on low flow sufficient to prevent air ingress into the furnace, so that there is a likelihood of introducing oxidizing conditions. With proportional control, on the other hand, a steady flow of gas is supplied, and, incidentally, a steady flow of atmosphere, which prevents the fluctuating conditions which cause air ingress.

(To be continued)

Men and Metals

At the recently held committee meeting of the Metal and Waste Traders' Association, **Mr. Lewis H. Hobday** was re-elected President of the association, with **Mr. P. H. Green** as vice-president. The following are members of the committee—**Mr. H. H. Barnett** (H. Barnett Ltd.) **Mr. F. Cogswell** (J. Thomas and Sons); **Mr. E. W. Cooper** (E. Austin and Sons (London) Ltd.); **Mr. A. S. Dandridge** (J. and A. Dandridge Ltd.); **Mr. J. J. Hunt** (James B. Hunt and Sons Ltd.); **Mr. J. C. Maybank** (J. and J. Maybank Ltd.); **Mr. A. R. New** (A. J. New and Son Ltd.); **Mr. N. Phillips** (P. Phillips and Son (Reading) Ltd.); and **Mr. C. A. Riddick** (Joseph Warrington Ltd.). **Mr. S. G. Peters** is honorary treasurer.

A director of the Kestner Evaporator and Engineering Company Limited, **Mr. G. H. Black,** is visiting the United States, where he is having conversations with a number of firms over a period of a few days.

Elected chairman of the Low Temperature Group of the Physical Society, **Dr. P. H. Sykes** is a director of the British Oxygen Company Limited. The Group was formed in 1946 to promote low temperature interest.

Export manager of the Midland Metal Spinning Company, **Mr. Robb** is leaving next week for a goodwill visit to the company's agents in Kenya, Rhodesia and South Africa.

An announcement has been made by Igranic Electric Company Limited to the effect that **Mr. R. L. Paice,** who has been sales director of the company since 1948, has relinquished this position and will now carry out special assignments for the Board. **Mr. A. W. Page,** as sales manager of the company, will now be responsible for the home and export sales organization.

Formerly Professor of Physical Metallurgy at Birmingham University, and at present with the Atomic Energy Research Authority, **Dr. A. H. Cottrell,** Ph.D., F.R.S., has been elected Goldsmiths' Professor of Metallurgy

at Cambridge University as from October 1 next in succession to **Professor G. Wesley Austin.** In 1954, Dr. Cottrell was awarded the Rosenhain Medal by the Institute of Metals in recognition of his outstanding contributions to knowledge in the field of physical metallurgy, with special reference to the deformation of metals.

It is learned from India that **Dr. B. R. Nijhawan,** Ph.D., F.I.M., F.N.I., director of the National Metallurgical Laboratory, Jamshedpur, has been given the award of "Padma Shri" by the President of the Union Republic of India in recognition of his exceptionally distinguished services in the fields of science in India.

From The General Electric Company Limited comes the news that, as from April 1 next, **Mr. R. N. Millar** will be appointed general manager of the company's Fraser and Chalmers engineering works at Erith. Mr. Millar will still be responsible for the company's atomic energy activities, but he will be assisted in this important field by **Dr. K. J. Wootton,** who will succeed Mr. Millar as manager of the company's atomic energy division.

Consequent upon the voluntary retirement of **Mr. L. J. Fairhurst,** it is announced by British Insulated Callender's Cables Limited that **Mr. T. P. Rome,** D.F.H., A.M.I.E.E., has been appointed to the position of Liverpool branch manager.

At the annual general meeting of **The Non-Ferrous Club,** held in Birmingham last week, **Mr. W. H. Demel** (Harrisons (B'ham) Ltd.) was elected as President; **Mr. H. McGhee** (Nicholson and Rhodes Ltd.) as chairman; **Mr. W. H. Vizor** (Deutsch and Brenner Ltd.) as secretary, and **Mr. T. B. Taylor** (E. A. Chalmers and Co. Ltd.) as treasurer. Members of the committee were appointed as follows: **Messrs. P. Mould** (Mould Bros. (Camp Hill) Ltd.), **N. L. B. Wright** (Hudson Edmunds and Co. Ltd.), **J. Raybould** (Leigh and Sillavan Ltd.), **R. L. Deutsch** (Deutsch and Brenner Ltd.), and **G. E. Lewis** ("Metal Industry").

NEW LABORATORIES AT G.E.C. ATOMIC ENERGY DIVISION, ERITH

Beryllium Research

FOR research work on the metallurgy and technology of beryllium a new laboratory has been established by The General Electric Company Limited at the headquarters of its Atomic Energy Division at Erith. Beryllium shows particular promise as a possible fuel-canning material, but it possesses certain toxic properties which make it necessary to adopt the most stringent precautions in all operations involving its use.

The construction, layout and equipment of the laboratory, and, above all, its elaborate ventilation system, have been carefully planned to ensure the maintenance of the highest standards of safety in the use of beryllium. In addition, a rigid code of practice has been evolved for all personnel using the building.

In general terms, the purpose of the laboratory can be described as the study of the chemical and physical properties of beryllium metal in fabricated form. The first stages of the programme are largely concerned with investigations on mechanical properties at elevated temperatures, and with measurements of oxidation resistance in carbon dioxide.

One of the major disadvantages of beryllium is its brittleness, and it is intended to pay particular attention to this aspect. In this connection, equipment for carrying out creep and stress-rupture investigations is at present being installed. Further subjects for future study include the welding of beryllium and the examination of the effects of aqueous corrosion.

Current information suggests that a beryllium fuel-can could probably be operated at temperatures of about 600°C. This would permit the maximum gas temperatures at the outlets from the reactor to be raised by at least 100°C. above the level possible in current designs. Such an increase would result in a considerably higher thermal efficiency for a nuclear power station. However, a great deal of work must be done in order to define the limiting conditions under which a beryllium-canned fuel element could be used.

Laboratory

For all normal purposes, the only means of entry to the laboratory is through a change room, which is divided into two parts separated by a barrier. On the entry side of this barrier, all personal clothing is left in lockers, while on the contact side complete laboratory clothing, including head- and foot-gear, is provided. In addition, there are washing facilities and a shower. A washing machine, complete with spin drier, and a drying cabinet are installed, as no laundry is sent out from the laboratory.

The laboratory itself is divided into two areas, A and B. The A area is designed for operations of greater potential hazard, and has a higher air-extraction rate than B.

The whole of the floor is covered with heavy-gauge linoleum, coved to the walls, and contains 25 drain points. Liquid effluent is discharged to a 400 gal. inspection and holding tank, which can be monitored. This tank acts as a water seal on the laboratory drains, so that air cannot be drawn into the building via the drainage system. A small filter is installed at each of the points where there is a danger of finely divided beryllium being discharged into the drain.

Since much experimental work is to be carried out in a pressurized carbon-dioxide atmosphere, a supply of this gas is piped round the laboratory at a pressure of 150 lb/in^2 gauge. A normal supply of compressed air is available but, in addition, a separate compressor is installed to provide a low-pressure, clean air supply for air masks and pressurized suits.

All laboratory services can be isolated from the service room, without having to enter the laboratory itself.

The laboratory areas are completely air-conditioned by means of one central inlet air duct, and two ranges of extract ducting which run along the laboratory walls at ceiling height.

The quantity of air extracted from the laboratory is greater than that admitted through the inlet manifolds. This ensures that a slight negative pressure is created in the laboratory, so that air leakage can only occur into the building.

Initially, all experimental procedures involving the handling of beryllium will be carried out in ventilated working boxes, each designed around a specific operation. All operations involving the formation of beryllium dust or chip (for example, machining, abrasion, and welding) are confined to Laboratory A, where the highest ventilation rate is available.

The boxes are of two types. For experimental work at elevated temperatures, they are constructed from sheet metal, on an angle-iron frame. For general laboratory techniques, such as metallography, a Perspex hood is attached to a conventional bench.

Access to the interior of the hood is gained through a Perspex working face. This face incorporates a single hinged door, opening outwards, and a series of sliding doors. The hinged door provides a single maximum opening in the box, which can be subdivided by means of the sliding doors. For welding work, a glove-box is used; access to this box is gained by means of arm-length rubber gloves sealed to the working face. This arrangement is, in fact, the familiar dry-box, modified to accommodate a high air velocity.

In spite of the elaborate precautions taken in the design of the installation,

Working boxes for experiments on oxidation and heat-treatment of beryllium

Metallography box in Laboratory A, with an air-sampling operation in progress (left); part of Laboratory B seen through the partition

it is essential if all risks of beryllium poisoning are to be completely avoided, for each laboratory operation to be proved safe before it is allowed to be conducted on a routine basis. Therefore, while a complete change of clothing followed by a shower at the end of the day is obligatory even for normal work in the laboratory, each new operation is initially performed in fully protective clothing with an external air line. Using this procedure, the operation in question can be carried out while air samples are taken at a number of points in the immediate vicinity of the operator. These samples provide a means of ascertaining that the operation can be conducted safely, that is, without exceeding, or indeed approaching, the maximum permissible level for atmospheric beryllium concentration. Once this has been established, the work can be continued without an air line or the associated protective clothing.

Beryllium monitoring is difficult, and, at present, the use of spectrochemical techniques on a batch-sampling basis provides the best safeguard. In collaboration with the G.E.C. Research Laboratories at Wembley, a sampling and analytical scheme has been established, using air samples of about 10 m^3. By the methods employed, as little as 0·015 millionths of a gramme of beryllium can be detected.

In addition to air monitoring on specific operations, routine background samples are taken daily in the laboratory over a period of 8 hr. Additional monitoring is employed for any unusual circumstances, such as swabbing down machines, or for any minor spills; on these occasions, fully protective clothing is worn.

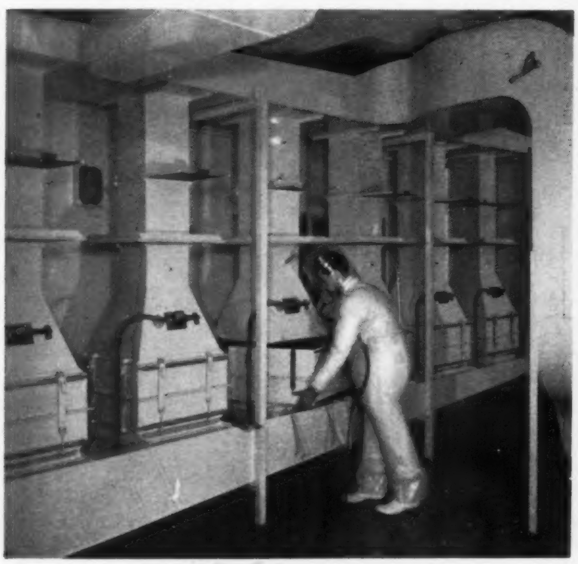
In addition to the beryllium laboratory, a number of other laboratories have been established, all aimed at extending the facilities for research into the gas-cooled graphite moderated reactor.

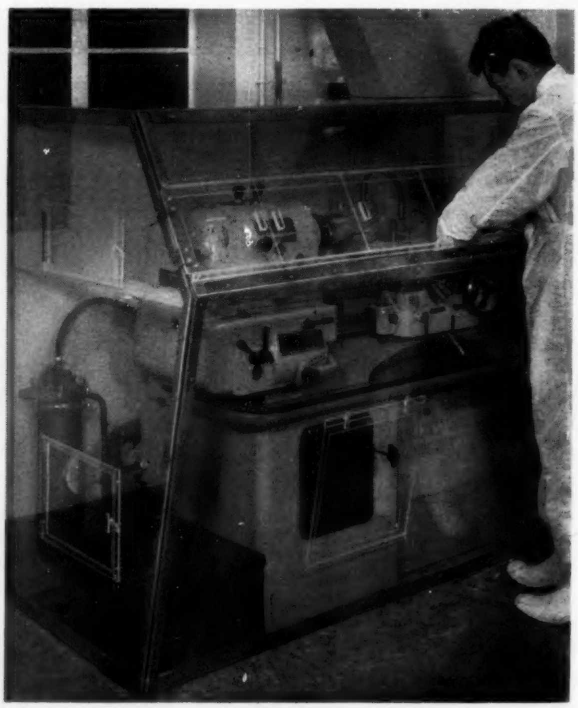
In one of these laboratories, the prototype of a remote-controlled power manipulator is undergoing its final tests. The first of its type to be designed and built in Europe, this manipulator is to be manufactured and marketed by the G.E.C. as a commercial product. The complete operation of the manipulator is controlled by one person from a small movable console, no mechanical linkage being employed.

Other new facilities include a laboratory mainly concerned with mechanical engineering problems, an existing building having been converted for the purpose. The same building also houses a new laboratory for experimental structural analysis. Additional administrative, design and drawing office accommodation has been built to house the increased number of staff, now totalling 450 compared with the 200 members of the Atomic Energy Division less than two years ago.

Below: One of the two banks of exhaust filters, with an operator in a pressurized suit changing a filter

Right: Lathe enclosed in its Perspex working box





Industrial News *Home and Overseas*

Summer School

Advance notices are issued of the fifth Summer School which the **Battersea College of Technology** is holding this year, commencing on July 14. The subject for the course is "Underground Corrosion and Cathodic Protection," and lectures will be given under the following headings: Underground Corrosion—An Introduction; Bacteriology of Corrosion; Corrosion of Non-Ferrous Metals; Protective Coatings; Cathodic Protection; and Instrumentation.

A demonstration will be given of various instruments used for assessing the corrosiveness of soils, protection of pipes, cathodic protection, etc., and a visit will be made to a site to see the installation of an underground pipe, soil testing, etc. The course will be from July 14 to 19, and the inclusive fee will be £12, including lunch and mid-morning and mid-afternoon refreshments, except for applicants who normally reside in London, or for those whose Local Education Authority will agree to pay the charges under the recoupment regulations. In these cases, the fee will be £5 10s. 0d. inclusive.

Applications for this school should be made to the Secretary (Summer School), Battersea College of Technology, Battersea Park Road, London, S.W.11, and all applications should be submitted before July 1 next.

Essay Competition

It has been decided by the Scientific Advisory Board of **Research** to continue the Waverley Gold Medal Essay Competition this year. This medal will be awarded for the best essay of about 3,000 words based on some recent scientific research or new development (whether the author's work or not), giving some indication of the scientific background, the experimental results, and its potential application in industry. A second prize of £50 will also be awarded, and an additional prize, also of £50, for the best entry from a competitor under 30 years of age on July 31 this year.

Full particulars regarding this competition may be obtained from the Editor, "Research," 4-5 Bell Yard, London, W.C.2. It should be noted that the competition is only open to persons at present engaged in scientific work. Entries must be received on or before July 31 next.

A Postponement

We recently published in this column details of a special conference dealing with electronic digital computers, to be held at the College of Technology, Birmingham, this month. It has now been announced that this event has had to be postponed until the autumn, due to unavoidable circumstances.

Statistical Sampling

A one-day conference on statistical sampling in industry, organized by the Birmingham Group of the Industrial Applications Section of the Royal Statistical Society is to be held at the **College of Technology, Birmingham,** on Wednesday, May 7 next.

It has become increasingly evident that the collection and analysis of numerical information is a basic need of industrial management. The collection of this information can be done simply, effectively, and economically by using suitable sampling methods. The speakers at the conference will, therefore, outline techniques designed for this purpose and indicate appropriate methods of analysis. The conference is designed to appeal particularly to people responsible for production, inspection, and accounting, as well as to statisticians.

The speakers will be Mr. E. D. Van Rest (Ministry of Suppy), Mr. R. H. S. Lesser (Philips Electrical Ind. Ltd.), Mr. F. S. Campbell (I.C.I. Metals Division), and Mr. H. C. Mackenzie (Bristol University). The conference fee is 30s., including lunch, and further details and application forms can be obtained from D. Goldberg, Esq., A.E.I., Lamp and Lighting Co. Ltd., Melton Road, Leicester.

Import Duties

An Additional Import Duties (No. 2) Order, 1958, has been made by the Treasury which increases the rate of duty payable under the Import Duties Act, 1932, on (a) antimony metal and oxides, and (b) certain antimony alloys and mixtures containing antimony oxides.

This Order came into operation on Friday of last week (March 21) and has been published as Statutory Instruments 1958 No. 404.

Furnace Contract

A new contract for electric furnaces, worth approximately half-a-million pounds, has been placed with **Birlec Limited** by the Newport Division of the Steel Company of Wales Limited for the production of special grades of steel for the electrical industry. Seventeen Birlec furnaces have already been installed by the Steel Company of Wales.

Birmingham Sales Office

New premises at Devonshire House, Great Charles Street, Birmingham, 3, have now been occupied by the Birmingham area sales offices of **Northern Aluminium Company Ltd.** The office will continue to be under the management of Mr. D. W. Taylor, to serve the needs of the Midland counties for all forms of Noral aluminium and aluminium alloy materials. The telephone number is Central 7393.

A London Removal

All the various departments of **Associated Lead Manufacturers Ltd.** are now housed in new and larger offices at Clements House, 14-18 Gresham Street, London, E.C.2, with the telephone number Monarch 4400. This address will also be that of Associated Lead Manufacturers Export Company Ltd.

Aluminium in Packaging

Eighth in the series organized almost annually by the **Aluminium Development Association,** a Symposium on "Aluminium in Packaging" will be held in London on June 11 next. The field to be covered is both varied and wide, with interest concentrated on non-returnable containers. Within this scope, eight Papers will be submitted for discussion.

There will be a morning and an afternoon session, and complete details will shortly be available from the offices of the association at 33 Grosvenor Street, London, W.1.

Mond Nickel at Belfast

Dramatic displays and working demonstrations are among the features of an exhibition to be held by the **Mond Nickel Company Ltd** at the Grand Central Hotel, Belfast, from April 14 to 18 next. The exhibition, which is designed to show the latest uses and developments of nickel, nickel alloys and related materials, will be open between 10 a.m. and 7 p.m. each day.

Numerous displays are being planned, to show corrosion resistance, surface protection, high magnetic permeability, weldability, controlled expansion, and mechanical properties at temperatures between 900°C. and sub-zero. One particularly dramatic demonstration shows how an alloy of platinum and rhodium can be used as a catalyst to re-ignite jet engines after a failure, and another exhibit will be a red-hot nickel alloy rod carrying a load equivalent to 7 tons/in^2. Part of the exhibition will be devoted to displays and tests of spheroidal graphite cast iron.

A New Address

It has been announced by **A. C. Scott and Co. Ltd.,** manufacturers of electrical resistance alloy wires and tapes, that they have now completed their removal to their new factory at Roundthorn, Wythenshawe, Manchester, 23.

Exhibiting at Milan Fair

It is announced by **Alexander Cardew Ltd.** that their principals—A. Triulzi, s.a.s., of Milan—are taking large stands at the Milan Fair, which is being held next month from April 12 to 25. On these stands will be shown the company's die-casting and plastics machines, including the latest developments in their production programme.

News from Birmingham

A fair rate of activity is maintained in the industrial Midlands. At this month's meeting of the Regional Board for Industry, Major C. R. Dibben, the chairman, said industry had suffered a slight check. "It would be wrong to think," he said, "that a recession is already here, or is even imminent. Unemployment is lower than at the same time last year. Order books seem to be rather shorter, but new orders are generally balancing the work completed." Considerable work is in progress amongst makers of electrical equipment. This is, in fact, a high spot because of the substantial outlay on new power stations both in this country and abroad. The outlook is favourable for a long way ahead in this respect. Motor trade output is maintained, despite a slight falling off in the orders for North America.

Most grades of steel are now in good supply, the principal exceptions being heavy plates and sheets. Users are still finding it necessary to import this kind of material, but otherwise there has been a decline in the buying of foreign steel as compared with a year ago. Activity in the motor trade benefits foundries who

specialize in that class of business. There is also a good market for castings for rolling stock builders and makers of heavy machinery. But foundries working for the building trade are short of orders. A local firm has received a contract worth £500,000 which is for special electric furnaces to go into new automatic production lines at the Newport plant of the Steel Company of Wales.

A Removal

We understand from **Ernest A. Lewis and Co. Ltd.,** the Birmingham metallurgical analysts, that they have now removed to their new premises at 26-32 Prince Albert Street, Bordesley Green, Birmingham, 9, and that their new telephone number is Victoria 1537.

Austrian Customs Duties

It is shortly proposed to submit to the Austrian Parliament the draft of the new customs tariff in which it is proposed to replace weight duties by *ad valorem* duties. The new tariff includes the following import duties for certain non-ferrous metals:—nickel pipes, 12 per cent; aluminium, 10 per cent; aluminium products 18-20 per cent, and lead pipes 14 per cent.

Scholarship Awards

It has been announced by **Crompton Parkinson (Stud Welding) Ltd.,** that a second cash award of $1,500—or $2,000 in scholarships for any individual or school of the winner's choice—will be given for the year's most outstanding contribution in the field of semi-automatic electric arc stud welding. A complete stud welding unit (tool, timer and generator power source) will also be presented to the engineering school or college whose students and faculty shall have submitted the most outstanding group of entries in this competition. Additional equipment awards to educational institutions will be made on the recommendation of the judges if warranted by the calibre and/or number of entries.

Residents in all countries where the Nelson stud welding process is in use are eligible for the award. Gregory Industries Inc., Lorain, Ohio, licence associates of Crompton Parkinson, are the sponsors of this competition, and the awards will be presented at the 1958 Awards Luncheon of the American Society for Metals in Cleveland, U.S.A., in October this year.

Entry forms and rules may be obtained from Crompton Parkinson (Stud Welding) Ltd., 1-3 Brixton Road, London, S.W.9. The closing date for entries is midnight, July 10, 1958.

Metal Finishing

On Thursday next, April 3, the North-West branch of the **Institute of Metal Finishing** will hold a meeting at the Engineers' Club, Albert Square, Manchester, at 7.30 p.m., when two short Papers will be presented—"What is a Plater?" by Mr. E. D. Chapman, and "Planning and Preparation of a Plating Shop," by Mr. A. Walmsley.

Fuel Efficiency

A Refresher Course organized by the North Wales Fuel Efficiency Panel of the Welsh Joint Education Committee, in co-operation with the National Industrial Fuel Efficiency Service, is to be held again this year at the Prestatyn Holiday Camp, North Wales, from June 9 to 14 next.

The title of the course will be "The Clean Air Act and Atmospheric Pollution Arising from Combustion Processes." The fee for residential students is £10 and for day students £4. Further details may be obtained from the Secretary to the Course, Mr. C. K. R. Davies, N.I.F.E.S., Baltic House, Mountstuart Square, Cardiff.

Metal Stocks

Stocks of refined tin in London Metal Exchange official warehouses at the end of last week totalled 17,927 tons, comprising London 5,836, Liverpool 11,001, and Hull 1,090 tons. Copper stocks totalled 19,411 tons and comprised London 11,334, Liverpool 6,758, Birmingham 965, Manchester nil, Swansea 175, and Hull 179 tons.

Chinese Tin on L.M.E.

A possibility that Chinese tin may be registered on the London Metal Exchange at some future date cannot be altogether disregarded, according to trade quarters. China is believed to be producing tin of 99·9, 99·56 and 99 per cent purity. Only the first grade, the 99·9 per cent, would qualify for inclusion in the Metal Exchange List, as tin cannot be registered and constitute a good delivery against the standard contract unless it assays at least 99·75 per cent.

Before the war, Chinese tin was traditionally of 99 and 98 per cent purity, and although it was not registered it was, nevertheless, deliverable against the standard contract at a discount. In order to qualify for registration, China would presumably have to guarantee that 99·9 per cent tin was being produced regularly and to agree to place tin at the disposal of the London Metal Exchange for analysis.

Nucleonic and Industrial Instruments

At a Press conference held in London last week, an announcement was made regarding the world-wide sales arrangement which has been entered into by **The Solartron Electronic Group Ltd.** and **Ericsson Telephones Ltd.** for the distribution of the many nucleonic and electronic instruments and components manufactured by the latter company. This new arrangement will have world-wide scope except in Scandinavia and South Africa, and includes the United Kingdom.

The instruments concerned cover those for hospitals, all forms of nuclear utilizations, atomic power, fire protection, industrial length and weight measurement, in fact for all industries where scientific instruments can be utilized, and for technical colleges and university laboratories.

Following the announcement made to the Press, several components from the range of instruments were shown, and a number of instruments were demonstrated, including nucleonic equipment, tachometry or counting and timing, counting and batching and the like.

Welding Electrodes

Construction of a nuclear power station at Bradwell-on-Sea, Essex, being undertaken by the Nuclear Power Plant Co. Ltd., for the Central Electricity Generating Board, is being aided by the Goliath crane, said to be the largest of its kind in existence in Britain. The Goliath is of the overhead girder type. It is supported at each end by a leg mounted on eight four-wheel bogies, which run on standard gauge railway lines.

The crane contains many large fabrications welded with Flexend electrodes. The same electrode was used to weld the Ferguson system tractors which took Sir Edmund Hillary to the South Pole. Flexend electrodes are made by **Rockweld Ltd.**

Professional Appointments

In its report for the year 1957, the Professional Engineers' Appointments Bureau states that a steady demand for engineers of all grades was maintained during the year, although some reduction in the numbers of vacancies notified became apparent during the latter months. Enrolments of engineers with the Bureau showed no obvious fluctuations and were similar to 1956, although not as high as the two previous years, when approximately 2,000 enrolments were recorded. The fall in vacancies has had its effect, but it is also due to the changing circumstances of the type of engineers using the services of the Bureau.

Placings have not been quite as high as in 1956, which has been partly due to the decrease in more junior placings. The shortage of well qualified young engineers, who have such a wide variety of vacancies from which to select, must inevitably be reflected in a lesser number being placed by the Bureau. The number on the register has been comparatively constant throughout the year, enabling fair selections to be made for the majority of vacancies notified. In general, notified vacancies have covered most branches of engineering, and many have been located in areas widely spread over the world.

There was a continued increase in those over 50 years of age who enrolled, without any comparable increase in vacancies where employers were prepared to consider this age group. As far as the Bureau was concerned, there appeared to be virtually no change in the attitude of employers to consider older men. The Bureau would like to draw attention to the recent change of address. The offices are now at 39 Victoria Street, London, S.W.1.

Copper Production in Ireland

It is reported from Dublin that production is scheduled to start at the Saint Patrick Mines in Avoca on July 1. Work on the new flotation mill on the site is now almost completed and already about 100,000 tons of ore have been stockpiled for immediate use. When working at full capacity, the new flotation mill will process some 4,000 tons of ore per day, producing 150 tons of copper and 400 tons of pyrite containing sulphur.

An official of the mines said that so far about £2 million had been spent on underground development and construction work on the surface. He added that the company was quite satisfied with the rate of progress and with the return of copper and sulphur. Meanwhile, exploratory work has ceased at two other Irish mines in which the Canadians were interested. At Castleblaney, County Monaghan, where efforts were made some 18 months ago to re-open the lead and zinc mines, all work has ceased. In Beauparc, where the Emerald Isle Mining Co. Ltd.—a subsidiary of Can-Erin Mines Ltd., of Toronto—were de-watering the shafts of the old copper mines, the work has been abandoned, and it is unlikely to

be restarted so long as the price of copper remains at its present level.

Showing at Brussels

At the World Exhibition, being held in Brussels next month, the Blackman Export Company Ltd. (the exporting subsidiary of **Keith Blackman Ltd.**) is participating by taking space on the Birmingham Exchange and Engineering Centre group stand in the British Industries Pavilion.

On this occasion, owing to space limitations, three standard fans only of basic type will represent the "Tornado" range. First is the No. 12 centrifugal, multivane type for general ventilation and air conditioning applications, mechanical draught, cooling and drying in connection with various manufacturing processes, etc. Second is one of the Type APA propeller type fans for use where large volumes of air have to be moved efficiently and quietly under free air or slight resistance conditions, for example, for foul air extraction from, or fresh air supply to, public buildings and industrial plants. The third exhibit is the bifurcated type fan which, since its introduction into the U.K. some seven years ago, and due to its unusual and practical design, has been made in very large numbers for handling actively corrosive fumes, for moving hot air and other gases created in industrial processes, and for mechanical draught.

Mining in Bolivia

News from La Paz is to the effect that the Mining Corporation of Bolivia, which controls the mines which formerly belonged to the three great enterprises known as Patino Mines, Hochschild and Aramayo Mines, has disclosed that between nationalization and the end of 1957 the decline in tin production amounted to 20·84 per cent.

In 1952, production was 27,348,902 kilos, but by 1957 output had declined to 21,648,353 kilos. This year the decline will be accentuated by the restriction imposed by the International Tin Council. Total tin output in February, 1957, was 1,872,839 kilos, and in the same month this year it was 1,155,308 kilos.

Zinc, silver, lead, copper, bismuth and gold also show a considerable decline in output since 1952. In the past two years no antimony has been mined. Wolfram is the only metal to show an advance. In 1952 output was 1,013,622 kilos, rising to 1,649,866 kilos in 1954. However, output in 1957 amounted to 1,165,305 kilos.

Soviet Non-Ferrous Industry

Some 50 per cent of the Soviet Union's non-ferrous ore output is mined by open-cast methods, according to the *Industrial and Economic Gazette*. But progress in open-cast mining technology is being hampered by the failure of the Soviet engineering industries to provide the necessary equipment in sufficient quantities, the journal asserts. There is an acute shortage of heavy rock excavators, powered trolleys and tipping trucks. But even in mines where there is no shortage of equipment, handling procedures are often unsatisfactory.

The journal claims that many ore enrichment plants fail to exploit their raw materials properly. For instance, selective flotation processes are not being introduced speedily enough at some of the major extraction plants. This is partly due to a shortage of chemicals required to operate the processes, and to their poor quality.

The journal goes on to say that there is need for the introduction of more electric furnaces into smelting plants, and for the provision of plant suitable for the processing of flue and ore dusts. The aluminium industry should be equipped with more powerful electrolytic furnaces, developing 100,000 to 130,000 amperes.

National Metal Exposition

In October this year, at the Cleveland Public Auditorium, Cleveland, U.S.A., the 40th National Metal Exposition and Congress will be held. The purpose of the Congress is to provide an opportunity for conferences at the top scientific level, and for an exchange of ideas among leading engineers and scientists from the metal-producing and fabricating countries of the world.

Space costs at the Exposition range from \$420 to \$7,015, according to size and location. United Kingdom firms interested in participating in the 1958 event, which is open from October 27 to 31 next, are invited to write direct to the organizers, American Society for Metals, 7301 Uclid Avenue, Cleveland, 3, Ohio. The Export Publicity and Fairs Branch of the Board of Trade, Lacon House, Theobalds Road, London, W.C.1, are able to give information on this event, and also have available a number of brochures about the Exposition.

Copper in Austria

Market observers in Vienna report that as a result of last year's 32 per cent price decline in copper prices on the world market, Austria's copper producers are encountering serious difficulties, especially since it appears that no measures of modernization or process improvement would be effective enough to make up for the price cut.

Meanwhile, in the hope that the decline in copper prices on world markets will come to an end in the next few years, the Austrian authorities are planning to extend help to the copper mining industry. A draft "Mining Development Law" is in preparation which foresees State aid for any non-ferrous metal mining enterprise which is in difficulties. Contributions to the fund for this purpose will be levied from other mines, processors of minerals, and from importers of non-ferrous metals.

However, industrial circles are opposed to this suggestion and point out that the levy will represent a heavy burden for those industries called upon to pay it and will inevitably result in price increases on the domestic market. This will, in turn, impair the competitive position of the processing industries.

A Move in the Midlands

This week has seen a removal of the Raw Materials Division of **George Cohen Sons and Company Ltd.**, from its old address in Corporation Street, Birmingham, to new premises at Trinity Road, Kingsbury, Tamworth, Staffs. The new telephone numbers are Hurley 281-2 and Ashfield 1191-3.

False Ceilings

One of the long-standing problems in the maintenance of escalator shafts at certain of London's Underground stations is the prevention of water seepage and consequent discoloration of the roof. This occurs where escalator shafts pass through water-bearing strata and is caused by water seeping through the joints between tunnel segments. To resolve this difficulty, London Transport is now experimenting with two types of false ceiling, using aluminium for one and plastics for the other.

The aluminium installation is in a three-bank escalator shaft at Hyde Park Corner station (Piccadilly Line), and includes a small area of flat ceiling at the top of the shaft in addition to the main curved ceiling over the escalator. The total area is about 6,300 ft^2.

The curved ceiling, 130 ft. long and of 22 ft. diameter, is constructed of 18 gauge (0·048 in.), 12 ft. 6 in. by 2 ft. 3 in. sheets in Noral M57S alloy of half-hard temper. These are secured to a steel framework of tees and angles by means of extruded cover strips in Noral 50 SW alloy, which are screwed to hardwood (ash) filler pieces on each side of the tees following the curvature of the roof. The longitudinal cover strips and the guttering at the lower edge of the ceiling are also of extruded sections secured in the same way. The flat area at the top of the shaft is constructed on the same principle as the curved ceiling, and the same materials are used.

To prevent attack of the aluminium, the whole of the back of the sheeting was given a coat of bituminous paint, and cadmium-plated screws were used throughout. The aluminium was supplied by **Northern Aluminium Company Limited** and anodized by the Acorn Anodising Company Limited to give a pleasing silver finish.

The other experimental false ceiling, which has been fitted in the shaft of a two-bank escalator at Bond Street station (Central Line) consists of sheets of a composite plastics material, having a white stoved finish, fitted over a framework, also of plastics. A similar installation is being fitted in an escalator shaft at Highgate station (Northern Line). The work has, in both cases, been carried out to the design and under the supervision of the London Transport Executive.

Both false ceilings have been designed so that any water seeping through on to the upper face of the sheets will run down into channels behind the advertisement panels on both sides of the shaft and discharge to the normal drainage system. Although different materials have been used in their construction, both ceilings share the advantages of being lightweight, resistant to corrosion, and impermeable to water. It is thought that one or both of these systems will provide a means of preventing the unsightly discoloration of escalator shafts.

Forthcoming Meetings

April 1—Institute of Metals. Oxford Local Section. Department of Metallurgy, The University, University Museum, Park Road, Oxford. Annual General Meeting and At Home. 7 p.m.

April 3—Institute of Metals. London Local Section. 17 Belgrave Square, London, S.W.1. Annual General Meeting, followed by "New Protective Coatings for Metals." W. E. Ballard. 6.30 p.m.

April 3—Institute of Metal Finishing. North-West Branch. Engineers' Club, Albert Square, Manchester. "What is a Plater?" E. D. Chapman. "Planning and Preparation of a Plating Shop." A. Walmsley. "Silk Screen Printing." F. Spicer. 7.30 p.m.

Metal Market News

STATISTICS for the month of January have been published by the British Non-Ferrous Metals Federation, which are as follows. Consumption of copper was 56,615 tons, or 8,000 tons better than December which, of course, suffered through the Christmas holiday and reductions in deliveries due to the onset of stocktaking. Stocks of copper, at 82,483 tons, were about 9,000 tons down. In lead, usage amounted to 29,607 tons, against 26,530 tons in December, while stocks dropped by 2,160 tons to 49,134 tons. In zinc, the trend was similar, for stocks fell by 1,600 tons to 43,308 tons, while consumption at 27,473 tons showed an increase of about 3,050 tons. Consumption of tin, at 1,762 tons, compared with 1,449 tons in the previous month. The American Copper Institute figures cover the month of February and, as usual, are divided between details of the situation inside the United States and those of the position outside the U.S.A. Particulars are given in short tons of 2,000 lb. Inside the U.S.A., production of crude copper was 93,029 tons, against 108,590 tons in January, while in refined quality the corresponding figures were 128,299 tons and 136,748 tons. Deliveries of refined copper were 93,784 tons, compared with 110,557 tons, while stocks rose from 176,287 tons at January 31 to 201,223 tons at the end of February. Outside the U.S.A., output of crude was 144,532 tons, against 156,791 tons, and of refined 119,447 tons, compared with 125,105 tons in January. Deliveries dropped from 149,321 tons to 130,392 tons, while stocks showed little change at 269,241 tons.

The rise in the price of copper last week was the most spectacular seen for some time and, be it said, perhaps the most difficult to explain, for neither in the United States nor yet on this side of the Atlantic was there any significant increase in demand for the metal. Basically, the outburst of speculation on the New York Commodity Exchange is responsible for the appreciation in London, but it led to a rise of ½ cent in the custom smelters' quotation to 23½ cents towards the end of the week. This appears to kill any chance of the import duty being put on before July 1, for this rally will not subside overnight, although there are obvious dangers inherent in the building up of a very big speculative bull position in New York. The turnover was well in excess of 11,000 tons, including business done on the Kerb, and on balance cash gained £7 5s. 0d. and three months £6 5s. 0d., the contango narrowing to 10s. L.M.E. stocks dropped by 150 tons to 19,822 tons. During the week two advances of each 50 points were made in the Belgian price, which finished at 24·25 francs per kilo. Other aids to bullish optimism were the cut of 10 per cent in the International Nickel Company's output of nickel, which, in practice, means copper also, and the reduction in the Bank Rate to 6 per cent. The contango, it will be noticed, narrowed to 10s., but during the week one settlement price stood at 30s. over the forward quotation, a state of affairs, however, which was fortunately of brief duration, being due apparently to technical considerations.

In tin, the turnover was about 1,425 tons, and values lost ground, cash being £1 10s. 0d. down and three months £3. A certain amount of uneasiness was apparent and it seemed that the Tin Council was buying on the market. In spite of the announcement that American stockpiling of both lead and zinc would shortly come to an end, prices of these metals gained ground. Lead, on a turnover of some 2,800 tons, put on £1 for March and 15s. for June, while zinc, in which about 3,300 tons changed hands, improved to the extent of 10s. prompt and 5s. forward. The question of increases in the U.S. duties on these metals is still not settled.

New York

Improved sentiment appeared in the U.S. copper market last week, aided by good custom smelter sales and a firmer tendency in copper futures on the New York Commodity Exchange. The steady advance reported from the London Metal Exchange also helped the U.S. market. Custom smelters said copper buying for the week was very satisfactory, and there was even some talk that the custom smelter price might be raised to 23 cents. However, the February statistics, which pointed to rising copper stocks, appeared to head off, temporarily, any custom smelter advance.

Meanwhile, the producer sector remained quiet. April order books were recently opened by the producers and they indicated that thus far their domestic sales were small. They also said that the volume booked in March was no better than in February. One leading producer source said that fabricators were low in copper inventories, but they knew they could get immediate delivery on any orders and so they saw no need to carry excess stocks. In addition, the orders from the car industry were still depressing, and bookings from other leading copper users were not yet showing any improvement. He believed that copper prices were near their bottom, but he could not foresee any sustained upturn in copper consumption until after the summer. Scrap copper was firmer by ⅜ of a cent per lb. to 17⅝ cents on the tightness of supplies.

Lead and zinc were, at the best, spotty markets and routine buying noted in both metals was preponderantly on an average price basis.

Leading trade sources said there were strong indications that the Tariff Commission would release its recommendations for higher tariff duties within a week or so.

The tin market eased off during the week, reflecting a decline in foreign markets and negligible buying interest in the United States. Light dealer covering and meagre consumer buying made up the activity for the week.

Chile

With the latest copper wire sales to the Soviet bloc, Chile's output of semi-processed copper for 1958 is now sold out, the Chilean Copper Department has announced. Total sales abroad amount to 32,000 tons. The Department has approved the sale of 10,500 tons of 5·8 mm. copper wire to the Soviet Union and 3,500 tons of wire over 6 mm. thick to East European countries. The Russian buyers have agreed to pay in dollars, in advance, through a Swiss banker, Mr. Otto Schilling, who is now in Santiago. The East European buyers are also dealing through Mr. Schilling. Last month a further 4,500 tons were sold to buyers in the Soviet bloc.

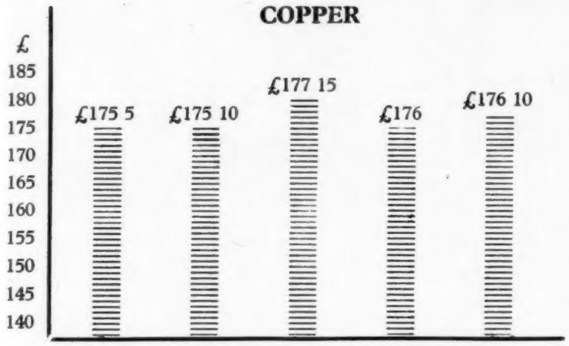
Malaya

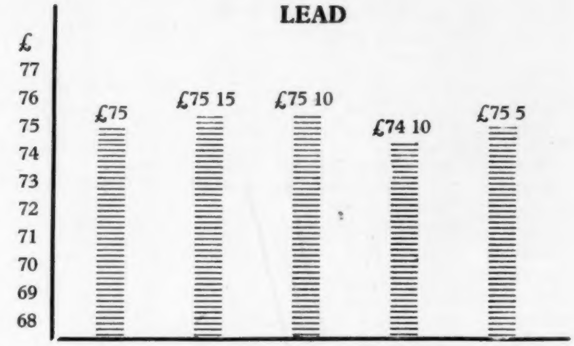
It is reported from Kuala Lumpur that Malayan miners have been warned against precipitate sales of their tin concentrates on April 1, when the second quota period of the tin restriction scheme begins. Counselled by the Ministry of Commerce and Industry, mining organizations are advising their members to spread out the sales of tin to the smelters so that the price is not sharply brought down by a sudden and excessive amount of tin being put on the market. Most of the mines, which several weeks ago completed their quota for the first period ending on March 31, have been working their mines and stockpiling their ore.

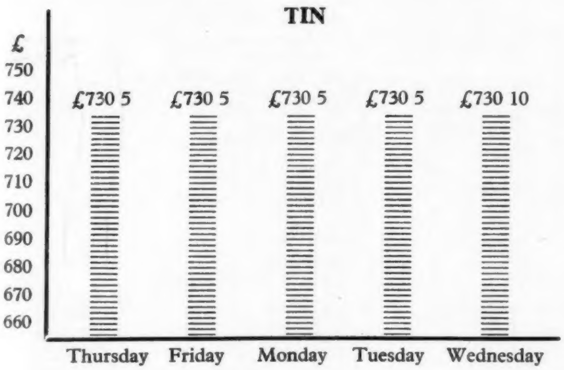
It is feared that miners in urgent need of cash would dump their second quota output on the first day of the second quota period. The percentage of the quota for European mines during the second quota period would be slightly in excess of that for the Chinese mines—the opposite of the first quota period. During the second period, Chinese mines would get 45·78 per cent of their quarterly assessment compared with 47·20 per cent for the European mines. This was because more Chinese mines had gone into production since the start of the tin registration scheme last December and thus the bulk quota reserved for the Chinese mines had to be distributed among a larger number of mines.

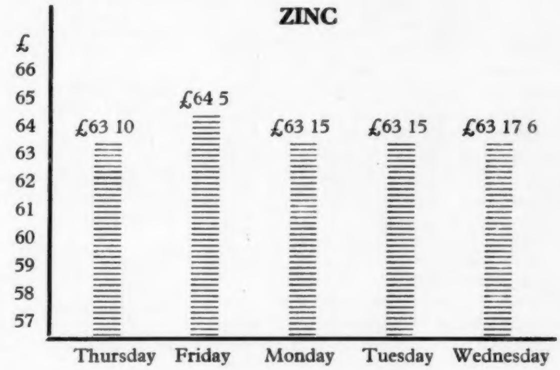
METAL PRICE CHANGES

LONDON METAL EXCHANGE, Thursday 20 March 1958 to Wednesday 26 March 1958









OVERSEAS PRICES

Latest avaliable quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

	Belgium fr/kg	≏ £/ton	Canada c/lb	≏ £/ton	France fr/kg	≏ £/ton	Italy lire/kg	≏ £/ton	Switzerland fr/kg	≏ £/ton	United States c/lb	≏ £/ton
Aluminium			24.63	203 10	210	182 15	400	232 0	2.50	209 0	28.10	224 17 6
Antimony 99.0					195	169 12 6	430	249 10			29.00	232 0
Cadmium					1,400	1,218 0	2,550	1,479 0			155.00	1,240 0
Copper												
Crude												
Wire bars 99.9							350	203 0				
Electrolytic	24.25	177 5	24.50	202 7 6	224	194 17 6			2.10	175 12 6	25.00	200 0
Lead			12.25	101 2 6	123	107 0	183	106 2 6	.95	79 10	13.00	104 0
Magnesium												
Nickel			71.50	590 10	1,205	104 17 6	1,330	771 10	7.80	652 5	74.00	592 0
Tin	102.50	749 5			898	781 5	1,430	829 10	8.70	727 10	95.25	762 0
Zinc												
Prime western			10.00	82 12 6							10.00	80 0
High grade 99.95			10.60	87 10 0								
High grade 99.99			11.00	90 5								
Thermic					107.12	93 2 6						
Electrolytic					115.12	100 2 6	157	91 0	.82	68 10	11.75	94 0

NON-FERROUS METAL PRICES

(All prices quoted are those available at 12 noon 26/3/58)

PRIMARY METALS

		£	s.	d.
Aluminium Ingots....	ton	197	0	0
Antimony 99·6%	„	197	0	0
Antimony Metal 99%..	„	190	0	0
Antimony Oxide......	„	180	0	0
Antimony Sulphide Lump..............	„	190	0	0
Antimony Sulphide Black Powder........	„	205	0	0
Arsenic..............	„	400	0	0
Bismuth 99·95%......	lb.		16	0
Cadmium 99·9%	„		10	0
Calcium	„	2	0	0
Cerium 99%	„	13	18	0
Chromium	„		6	11
Cobalt	„		16	0
Columbite.... per unit			—	
Copper H.C. Electro..	ton	176	10	0
Fire Refined 99·70%	„	175	0	0
Fire Refined 99·50%	„	174	0	0
Copper Sulphate....	„	66	0	0
Germanium	grm.		—	
Gold	oz.	12	9	3
Indium	„		10	0
Iridium..............	„	26	0	0
Lanthanum	grm.		15	0
Lead English..........	ton	75	5	0
Magnesium Ingots....	lb.		2	5½
Notched Bar........	„		2	10½
Powder Grade 4......	„		6	3
Alloy Ingot, A8 or AZ91	„		2	8
Manganese Metal....	ton	300	0	0
Mercury	flask	77	0	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5	5
F. Ingot............	„		5	6
Osmium	oz.		nom.	
Osmiridium	„		nom.	
Palladium	„	7	10	0
Platinum............	„	26	15	0
Rhodium............	„	40	0	0
Ruthenium	„	16	0	0
Selenium	lb.		nom.	
Silicon 98%..........	ton		nom.	
Silver Spot Bars......	oz.		6	4⅛
Tellurium	lb.		15	0
Tin..................	ton	730	10	0
Titanium............	lb.		19	6
***Zinc**				
Electrolytic..........	ton		—	
Min 99·99%	„		—	
Virgin Min 98%....	„	63	16	3
Dust 95/97%........	„	104	0	0
Dust 98/99%........	„	110	0	0
Granulated 99+% ..	„	88	16	3
Granulated 99·99+%	„	101	16	3

**Duty and Carriage to customers' works for buyers' account.*

INGOT METALS

Aluminium Alloy (Virgin)		£	s.	d.
B.S. 1490 L.M.5	ton	227	0	0
B.S. 1490 L.M.6	„	217	0	0
B.S. 1490 L.M.7	„	231	0	0
B.S. 1490 L.M.8	„	220	0	0
B.S. 1490 L.M.9	„	218	0	0
B.S. 1490 L.M.10....	„	236	0	0
B.S. 1490 L.M.11....	„	231	0	0
B.S. 1490 L.M.12....	„	240	0	0
B.S. 1490 L.M.13....	„	231	0	0
B.S. 1490 L.M.14....	„	241	0	0
B.S. 1490 L.M.15....	„	227	0	0
B.S. 1490 L.M.16....	„	222	0	0
B.S. 1490 L.M.18....	„	220	0	0
B.S. 1490 L.M.22....	„	228	0	0

		£	s.	d.
†Aluminium Alloy (Secondary)				
B.S. 1490 L.M.1	ton	155	0	0
B.S. 1490 L.M.2	„	161	10	0
B.S. 1490 L.M.4	„	182	10	0
B.S. 1490 L.M.6	„	204	10	0
†Average selling prices for February				
***Aluminium Bronze**				
BSS 1400 AB.1......	ton	194	0	0
BSS 1400 AB.2......	„	210	0	0
***Brass**				
BSS 1400-B3 65/35 ..	„	129	0	0
BSS 249	„		—	
BSS 1400-B6 85/15..	„		—	
***Gunmetal**				
R.C.H. 3/4% ton....	ton		—	
(85/5/5/5)		155	0	0
(86/7/5/2)	„	168	0	0
(88/10/2/1)	„	212	0	0
(88/10/2/½)	„	222	0	0
Manganese Bronze				
BSS 1400 HTB1....	„	188	0	0
BSS 1400 HTB2....	„		—	
BSS 1400 HTB3....	„	185	0	0
Nickel Silver				
Casting Quality 12%	„		nom.	
„ „ 16%	„		nom.	
„ „ 18%	„		nom.	
***Phosphor Bronze**				
2B8 guaranteed A.I.D. released	„	240	0	0
Phosphor Copper				
10%	„	206	0	0
15%	„	215	0	0

**Average prices for the last week-end.*

		£	s.	d.
Phosphor Tin				
5%	ton		—	
Silicon Bronze				
BSS 1400-SB1	„		—	
Solder, soft, BSS 219				
Grade C Tinmans....	„	347	0	0
Grade D Plumbers ..	„	281	6	0
Grade M	„	379	9	0
Solder, Brazing, BSS 1845				
Type 8 (Granulated)	lb.		—	
Type 9 „	„		—	
Zinc Alloys				
Mazak III	ton	95	1	3
Mazak V	„	99	1	3
Kayem	„	105	1	3
Kayem II	„	111	1	3
Sodium-Zinc........	lb.		2	5

SEMI-FABRICATED PRODUCTS

Prices of all semi-fabricated products vary according to dimensions and quantities. The following are the basis prices for certain specific products.

Aluminium		£	s.	d.
Sheet 10 S.W.G.	lb.		2	9
Sheet 18 S.W.G.	„		2	11
Sheet 24 S.W.G.	„		3	2
Strip 10 S.W.G.	„		2	9
Strip 18 S.W.G.	„		2	10
Strip 24 S.W.G.	„		2	11½
Circles 22 S.W.G.	„		3	3
Circles 18 S.W.G.	„		3	2
Circles 12 S.W.G.	„		3	1
Plate as rolled........	„		2	8½
Sections..............	„		3	2½
Wire 10 S.W.G.......	„		3	0
Tubes 1 in. o.d. 16 S.W.G.	„		4	1

		£	s.	d.
Aluminium Alloys				
BS1470. HS10W.	lb.			
Sheet 10 S.W.G.	„		3	1¼
Sheet 18 S.W.G.	„		3	4
Sheet 24 S.W.G.	„		3	11¼
Strip 10 S.W.G.	„		3	1¼
Strip 18 S.W.G.	„		3	3
Strip 24 S.W.G.	„		3	11
BS1477 HP30M.				
Plate as rolled			2	11½
BS1470. HC15WP.				
Sheet 10 S.W.G.	lb.		3	9¼
Sheet 18 S.W.G.	„		4	1¼
Sheet 24 S.W.G.	„		4	11¼
Strip 10 S.W.G.	„		3	10¼
Strip 18 S.W.G.	„		4	1¼
Strip 24 S.W.G.	„		4	9
BS1477. HPC15WP.				
Plate heat treated..	„		3	6¼
BS1475. HG10W.				
Wire 10 S.W.G.	„		3	10¼
BS1471. HT10WP				
Tubes 1 in. o.d. 16 S.W.G.	„		5	0
BS1476. HE10WP.				
Sections	„		3	2
Beryllium Copper				
Strip	„	1	4	11
Rod................	„	1	1	6
Wire	„	1	4	9
Brass Tubes..........	„		1	5
Brazed Tubes........	„		—	
Drawn Strip Sections	„		—	
Sheet	ton		—	
Strip	„	199	15	0
Extruded Bar........	lb.		1	8⅛
Extruded Bar (Pure Metal Basis)	„		—	
Condenser Plate (Yellow Metal)........	ton	145	0	0
Condenser Plate (Naval Brass)	„	156	0	0
Wire	lb.		2	3⅛
Bronze Sheet and Strip	ton		—	
Copper Tubes........	lb.		1	8⅜
Sheet	ton	200	5	0
Strip	„	200	5	0
Plain Plates..........	„		—	
Locomotive Rods	„		—	
H.C. Wire	„	223	15	0
Cupro Nickel				
Tubes 70/30	lb.		3	2
Lead Pipes (London) ..	ton	115	5	0
Sheets (London)	„	113	0	0
Tellurium Lead......	„	£6 extra		
Nickel Silver				
Rods	lb.		—	
Sheet and Strip 7%..	„		3	2
Wire 10%	„		3	8½
Phosphor Bronze				
Wire	„		3	5½
Titanium				
Billet	lb.	4	10	0
Sheet	„	6	12	0
Wire	„	9	10	0
Tube	„	16	0	0
Zinc Sheets, English destinations	ton	98	0	0
Strip	„		nom.	

Scrap Metal Prices

Merchants' average buying prices delivered, per ton, 25/3/58.

	£
Aluminium	
New Cuttings	160
Old Rolled	130
Segregated Turnings	100
Brass	
Cuttings	112
Rod Ends	109
Heavy Yellow	95
Light	90
Rolled	104
Collected Scrap	93
Turnings	104
Copper	
Wire	153
Firebox, cut up	153
Heavy	148
Light	143
Cuttings	153
Turnings	140
Braziery	120

	£
Gunmetal	
Gear Wheels	150
Admiralty	150
Commercial	126
Turnings	121
Lead	
Scrap	65/10
Nickel	
Cuttings	—
Anodes	525
Phosphor Bronze	
Scrap	126
Turnings	121
Zinc	
Remelted	—
Cuttings	40
Old Zinc	28

The latest available scrap prices quoted on foreign markets are as follow. (The figures in brackets give the English equivalents in £1 per ton):—

West Germany (D-marks per 100 kilos):		
Used copper wire	(£156.12.6)	180
Heavy copper	(£152.5.0)	175
Light copper	(£130.10.0)	150
Heavy brass	(£100.0.0)	115
Light brass	(£69.12.6)	80
Soft lead scrap	(£61.0.0)	70
Zinc scrap	(£39.2.6)	45
Used aluminium unsorted	(£87.0.0)	100
France (francs per kilo):		
Copper	(£200.2.6)	230
Heavy copper	(£200.2.6)	230
Light brass	(£143.10.0)	165
Zinc castings	(£67.0.0)	77
Tin	(£565.10.0)	650
Aluminium pans (98½ per cent)	(£130.10.0)	150

Italy (lire per kilo):		
Aluminium soft sheet clippings (new)	(£194.7.6)	335
Aluminium copper alloy	(£104.10.0)	180
Lead, soft, first quality	(£87.0.0)	150
Lead, battery plates	(£52.5.0)	90
Copper, first grade	(£162.10.0)	280
Copper, second grade	(£150.17.6)	260
Bronze, first quality machinery	(£165.7.6)	285
Bronze, commercial gunmetal	(£136.7.6)	235
Brass, heavy	(£113.2.6)	195
Brass, light	(£101.10.0)	175
Brass, bar turnings	(£116.0.0)	200
New zinc sheet clippings	(£55.2.6)	95
Old zinc	(£40.12.6)	70

Financial News

New Companies

The particulars of companies recently registered are quoted from the daily register compiled by Jordan and Sons, Limited, Company Registration Agents, Chancery Lane, W.C.2.

Tomkins Plating Company Limited (598271), Littleton Street, Walsall. Registered February 3, 1958. Nominal capital, £1,500 in £1 shares. Directors: Arthur H. Tomkins, Robt. W. Tomkins and Ralph H. Tomkins.

H. T. Brigham and Company Limited (598418), Station Road, Coleshill, Warwickshire. Registered February 5, 1958. To take over business of metal presswork and toolmakers, etc., carried on as "H. T. Brigham and Company" at Coleshill, Warwickshire, and also at 176 Berners Street, Lozells, Birmingham. Nominal capital, £10,000 in £1 shares. Permanent directors: Hugh T. Brigham and Florence E. Brigham.

Midland Metal Finishers Ltd. (598440), Station Works, Wallingford, Berks. Registered February 5, 1958. To take over business of metal polishers carried on as "Midland Enterprise" at Crouch Street, Banbury, Oxon., etc. Nominal capital, £1,000 in £1 shares. Directors: Edward C. Wallace, Sydney F. Hissett and Chas. H. R. Dowell.

Deeweld Limited (598454), 2 Pepper Street, Chester. Registered February 6, 1958. To carry on business of designers, manufacturers, suppliers, repairers, factors, agents, and hirers of welding plant, etc. Nominal capital, £1,000 in £1 shares. Permanent directors: Laurence Burns and John L. Roberts.

Parnell Brothers Limited (598474), Midland Foundry and Engineering Works, Church Lane, Wolverhampton. Registered February 6, 1958. To carry on business of founders, processors, extruders, machinists, fabricators, welders, moulders and finishers of all non-ferrous metals and materials, including plastics, etc. Nominal capital, £10,000 in £1 shares. Directors: James R. Parnell and Robert Bromley.

Renweld Limited (598476), Nelson Street, Oldbury, Worcs. Registered February 6, 1958. To carry on business of welders of ferrous or non-ferrous metals or alloys, etc. Nominal capital, £1,000 in £1 shares. Directors to be appointed by subscribers.

Trade Publications

H.C. Copper Busbars.—Thomas Bolton and Sons Limited, Mersey Copper Works, Widnes, Lancs.

Bound in loose-leaf style with a copper-coloured cover, this 24-page brochure deals with Bolton's H.C. copper busbars and describes rectangular sections, switch leaves, flexible connections, etc., tubular busbars, copper clad steel tubes, cellular conductors, research services, etc., together with a number of excellent illustrations.

Switchboard and Panel Instruments.—The English Electric Company Ltd., Foregate Street, Stafford.

Five new booklets have recently been issued in which details, photographs and statistical data are given relating to the switchboard instruments and various panel instruments produced by this company.

Nuclear Equipment. — Ayling Nuclear Equipment Company Ltd., Ayling House, Horsham, Sussex.

Remote handling equipment for atomic research work, electronic control gear, testing apparatus and special purpose machinery made by the Ayling Industries Group of companies are described in a 12-page brochure. Apart from the English text, the brochure contains translations in French, German and Spanish, as well as a number of excellent photographs.

Electrical Products. — English Electric Valve Company Ltd., Chelmsford, Essex.

Recent literature distributed by this company includes an eight-page brochure drawing attention to their germanium power rectifiers and, in particular, to the VA713 rectifier, a germanium power diode with a mean current rating of 4½ amps. at 55°C. ambient temperature. Another booklet gives provisional data of the M554, a high power magnetron which has been added to the company's range of pulse operated magnetrons, while a leaflet describes the E.E.V. type K350 two-resonator C.W. Klystron oscillator which has been specificially designed to have the low noise modulation and good frequency stability demanded by airborne F.M. radar applications.

Product Sketches.—Union Carbide Ltd., Alloys Division, 103 Mount Street, London, W.1.

The Alloys Division of this company is currently handling over 160 different ferro alloys and metals—a very considerable range and one that, in its entirety, is not easily made known. Consequently, to at least partially overcome this problem, a new publication, "Product Sketches," attempts to detail briefly the grades which are available, whilst at the same time enlivening the effort with a few snatches of metallurgical history and a sprinkling of thumbnail sketches. Further, the products are divided into groups which allow easy reference and avoid the need for intensive research before the particular item of interest is located. The classifications are chromium, silicon, manganese, zirconium, briquetted alloys, boron, calcium, columbium, titanium, tungsten, vanadium, and "others."

THE STOCK EXCHANGE

New Bank Rate Resulted In Temporary Buoyancy, But Dull Tendency Followed

ISSUED CAPITAL ●	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 25 MARCH	+RISE —FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1958 HIGH	1958 LOW	1957 HIGH	1957 LOW
£	£				Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	18/6	+6d.	10	10	10 16 3	19/9	17/9	28/3	18/-
400,000	2/-	Anti-Attrition Metal	1/6		8½	7½	11 6 9	1/6	1/3	2/6	1/6
33,639,483	Stk. (£1)	Associated Electrical Industries ...	51/-	+1/6	15	15	5 17 9	51/-	47/-	72/3	47/9
1,590,000	1	Birfield Industries	50/-	—6d.	15	20N	6 0 0	53/9	50/-	70/-	48/9
3,196,667	1	Birmid Industries	57/-	+9d.	17½	17½	6 2 9	57/9	56/3	80/6	55/9
5,630,344	Stk. (£1)	Birmingham Small Arms	24/3	+6d.	10	8	8 5 0	26/7½	23/9	33/-	21/9
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	15/7½	+4½d.	5	5	6 8 0	15/7½	14/7½	16/-	15/-
350,580	Stk. (£1)	Ditto Cum. B. Pref. 6%	16/10½		6	6	7 2 3	17/-	16/6	19/-	16/6
500,000	1	Bolton (Thos.) & Sons	26/10½		12½	12½	9 6 0	28/9	26/10½	30/3	28/9
300,000	1	Ditto Pref. 5%	15/6		5	5	6 9 0	—		16/9	14/3
160,000	1	Booth (James) & Co. Cum. Pref. 7%	19/3		7	7	7 5 6	19/3	19/-	22/3	18/9
9,000,000	Stk. (£1)	British Aluminium Co.	46/6	+1/-	12	12	5 3 3	46/6	41/3	72/-	38/3
1,500,000	Stk. (£1)	Ditto Pref. 6%	18/9		6	6	6 8 0	19/3	18/4½	21/6	18/-
15,000,000	Stk. (£1)	British Insulated Callender's Cables	42/-	+2/-	12½	12½	5 19 0	42/-	38/10½	55/-	40/-
17,047,166	Stk. (£1)	British Oxygen Co. Ltd., Ord ...	34/6	+1/6	10	10	5 16 0	34/6	29/-	39/-	29/6
600,000	Stk. (5/-)	Canning (W.) & Co.	21/-	+1½d.	25	25	5 19 0	21/-	20/1½	24/6	19/3
60,484	1/-	Carr (Chas.)	2/3		25	25	X 7 15 6	2/3	2/-	3/6	2/1½
150,000	2/-	Case (Alfred) & Co. Ltd.	4/4½		25	25	11 8 6	4/9	4/4½	4/6	4/-
555,000	1	Clifford (Chas.) Ltd.	16/4½		10	10	12 4 3	16/6	16/-	20/6	15/9
45,000	1	Ditto Cum. Pref. 6%	15/10½		6	6	7 11 3	—		17/6	16/-
250,000	2/-	Coley Metals	3/3		25	25	15 7 9	4/6	3/3	5/7½	3/9
8,730,596	1	Cons. Zinc Corp.†	46/9	—3d.	22½	22½	9 12 6	51/6	43/-	92/6	49/-
1,136,233	1	Davy & United	45/9	—6d.	15	12½	6 11 0	48/-	45/9	60/6	42/6
2,750,000	5/-	Delta Metal	19/10½	+3d.	*17½	*17½	4 8 0	21/4½	19/7½	28/6	19/-
4,160,000	Stk. (£1)	Enfield Rolling Mills Ltd.	27/6	+1/6	15B	22½	9 1 9	27/6	24/-	38/6	25/-
500,000	1	Evered & Co.	39/-		15	15	7 13 9	41/3	39/-	52/9	42/-
18,000,000	Stk. (£1)	General Electric Co.	31/7½	+2/1½	12½	14	Y 7 5 6	38/7½	29/6	59/-	38/-
1,250,000	Stk. (10/-)	General Refractories Ltd.	33/-	+1/-	20	17½	6 1 3	33/-	27/3	37/-	26/9
401,240	1	Gibbons (Dudley) Ltd.	65/6		15	12	4 11 9	66/3	64/-	71/-	53/-
750,000	5/-	Glacier Metal Co. Ltd.	6/-	+3d.	11½	11½	9 11 9	6/-	5/7½	8/1½	5/10½
1,750,000	5/-	Glynwed Tubes	13/3	—1½d.	20	20	7 11 0	13/6	12/10½	18/-	12/6
5,421,049	10/-	Goodlass Wall & Lead Industries ...	20/-xcap	+9d.	18Z	16	6 0 0	20/-	19/3	37/3	28/9
342,195	1	Greenwood & Batley	46/10½		17½	17½	7 9 3	—		50/-	46/-
396,000	5/-	Harrison (B'ham) Ord.	12/4½		*15	*30‡	6 1 3	12/4½	11/6	16/9	12/4½
150,000	1	Ditto Cum. Pref. 7%	18/9		7	7	7 9 3	—		22/3	18/7½
1,075,167	5/-	Heenan Group	7/1½	—1½d.	10	20‡	7 0 3	7/7½	6/9	10/4½	6/9
142,045,750	Stk. (£1)	Imperial Chemical Industries ...	40/6	+2/-	10	10	4 18 9	40/6	36/6	46/6	36/3
33,708,769	Stk. (£1)	Ditto Cum. Pref. 5%	16/3	+3d.	5	5	6 3 0	17/1½	16/-	18/6	15/6
14,584,025	**	International Nickel	143		$3.75	$3.75	4 14 0	144½	136½	222	130
430,000	5/-	Jenks (E. P.), Ltd.	7/3xcap	—3d.	27½ ϕ	27½	9 9 9	7/9¾	7/3	18/10½	15/1½
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	15/-		5	5	6 13 3	—		17/-	14/6
3,987,435	1	Ditto Ord.	40/-	+6d.	10	9	5 0 0	41/3	37/6	58/9	40/-
600,000	10/-	Keith, Blackman	16/3		15	15	9 4 6	16/3	15/-	21/9	15/-
160,000	4/-	London Aluminium	3/9	+3d.	10	5	10 13 3	4/3	3/6	6/9	3/6
2,400,000	1	London Elec. Wire & Smith's Ord....	42/-	+1/-	12½	12½	5 19 0	42/-	39/9	54/6	41/-
400,000	1	Ditto Pref.	22/9		7½	7½	6 11 9	—		25/3	21/9
765,012	1	McKechnie Brothers Ord.	35/-		15	15	8 11 6	—		48/9	37/6
1,530,024	1	Ditto A Ord.	32/6		15	15	9 4 6	—		47/6	36/-
1,108,268	5/-	Manganese Bronze & Brass	10/3	+6d.	27½‡	25	6 14 3	10/3	9/-	21/10½	7/6
50,628	6/-	Ditto (7½% N.C. Pref.)	6/-	+3d.	7½	7½	7 10 0	6/-	5/9	6/6	5/-
13,098,855	Stk. (£1)	Metal Box	46/-	+1/3	20‡	15M	4 7 0	46/-	41/9	59/-	40/3
415,760	Stk. (2/-)	Metal Traders	6/6	+3d.	50	50	15 7 9	6/6	6/3	8/-	6/3
160,000	1	Mint (The) Birmingham	21/9	—3d.	10	10	9 4 0	22/9	21/9	25/-	21/6
80,000	5	Ditto Pref. 6%	83/6		6	6	7 3 9	—		90/6	83/6
3,064,930	Stk. (£1)	Morgan Crucible A	40/-	+1/-	10	11	5 0 0	40/-	34/-	54/-	35/-
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref. ...	17/-		5½	5½	6 9 6	17/3	17/-	19/3	16/-
2,200,000	Stk. (£1)	Murex	54/6	+9d.	20	20	7 6 9	57/6	53/9	79/9	57/-
468,000	5/-	Ratcliffs (Great Bridge)	7/3	+1½d.	10	10	6 19 0	7/3	6/10½	8/-	6/10½
234,960	10/-	Sanderson Bros. & Newbould ...	27/-		27½D	27½	6 15. 9	27/-	26/-	41/-	24/9
1,365,000	Stk. (5/-)	Serck Radiators	11/6	+6d.	17½Z	15	5 1 6	12/-	11/-	18/10½	11/6
600,400	Stk. (£1)	Stone (J.) & Co. (Holdings)	43/9		16	16	7 6 6	—		57/6	43/9
600,000	1	Ditto Cum. Pref. 6½%	20/-		6½	6½	6 10 0	—		21/9	18/9
14,494,862	Stk. (£1)	Tube Investments Ord.	53/-	+1/-	15	15	5 13 3	53/9	48/4½	70/9	50/6
41.000,000	Stk. (£1)	Vickers	30/-		10	10	6 13 3	31/-	29/4½	46/-	29/-
750,000	Stk. (£1)	Ditto Pref. 5%	15/3		5	5	6 11 3	15/6	14/9	18/-	14/-
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	22/-		*5	*5	6 19 9A	23/-	21/3	24/9	20/7½
2,200,000	1	Ward (Thos. W.), Ord.	75/6	+1/9	20	15	5 6 0	75/6	70/9	83/-	64/-
2,666,034	Stk. (£1)	Westinghouse Brake	36/6	+1/-	10	18P	5 9 6	36/6	32/6	85/-	29/1½
225,000	2/-	Wolverhampton Die-Casting ...	7/7½	+1½d.	25	40	6 11 3	7/9	7/2½	10/1½	7/-
591,000	5/-	Wolverhampton Metal	15/4½		27½	27½	8 19 0	15/6	14/9	22/3	14/9
78,465	2/6	Wright, Bindley & Gell	3/3		20	17½E	15 7 9	3/9¾	3/3	3/9	2/7½
124,140	1	Ditto Cum. Pref. 6%	11/6		6	6	10 8 9	—		12/6	11/3
150,000	1/-	Zinc Alloy Rust Proof	2/10½		40D	33½	9 5 6	3/1½	2/7½	5/-	2/9

*Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting **Shares of no Par Value. ‡ and 100% Capitalized issue. ● The figures given relate to the issue quoted in the third column. A Calculated on £7 14 6 gross. H and 200% capitalized issue. M and 10% capitalized issue. Y Calculated on 11½% dividend. ||Adjusted to allow for capitalization issue. E for 15 months. P and 100% capitalized issue, also "rights" issue of 2 new shares at 35/- per share or £3 stock held. D and 50% capitalized issue. Z and 50% capitalized issue. B equivalent to 12½% on existing Ordinary Capital after 100% capitalized issue. ϕ And 100% capitalized issue. X Calculated on 17½%.